Electrical World

The consolidation of ELECTRICAL WORLD and ENGINEER AND AMERICAN ELECTRICIAN.

VOL. 58. NEW YORK, SATURDAY, AUGUST 26, 1911. No. 9.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK.

JAMES H. McGRAW, President.
HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITOR ..... W. D. Weaver
A. S. M'ALLISTER ..... Associate Editor
W. H. ONKEN, JR. ..... Associate Editor
W. E. KEILY ..... Associate Editor
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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All other countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Changes of advertising copy should reach this office ten days in advance of date of issue if proofs are desired. New advertisements will be accepted up to noon of Wednesday of the week of issue.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 was 974,750. Of this issue 17,000 copies are printed.

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A NOTABLE ISOLATED PLANT.

The description, completed in the current issue, of the great power and lighting plant for the new Northwestern Passenger Station in Chicago gives an impressive idea of what is really one of the most complete isolated plants in the country. It would call for close consideration merely on account of its size, for its total capacity of hard upon 3000 kw is exceptionally large for a plant devoted to general purposes. There are few larger ones for private service save in the case of some plants especially devoted to motor service. Perhaps the most striking thing, from an engineering standpoint, about the whole plant is the deliberate installation of compound, non-condensing engines in connection with a low-pressure steam turbine. The economy of such a combination is, of course, well known, but the turbine has in practically every case been an afterthought, while here, in view of the impracticability of getting a suitable source of condensing water, the turbine immediately became an essential factor in station economy. The engines themselves give for their type rather exceptional results, being guaranteed for 18.6 lb. of steam per ihp at full load, while operating at 16.5 lb. absolute back pressure. The low-pressure turbine was guaranteed to deliver a kw-hour on 43.5 lb. of this exhaust steam, and when the whole system is at full load the net result comes down to 11.8 lb. of steam per hp-hour—a beautiful example of shrewd design for maximum economy. The turbine alone is provided with a cooling tower.

There are many interesting features in the arrangements for the control and distribution of the output of this great station, of which it is only necessary here to remark that the remote control of the system is worked out in an extraordinarily complete way and is the sole reliance of the plant. The equipment operated by the installation is a very intricate one, as is to be expected from the service of a building of this character, including the complete lighting of the terminal, the lighting of standing trains, a considerable amount of special and street lighting, pumping, mechanical ventilation, elevators, vacuum cleaning, refrigeration and other miscellaneous output. Nearly 1000 hp in motors for these various utilities is regularly in use. The lighting of the station is, of course, the chief work of the plant during the hours of heavy load. It is almost entirely by tungsten lamps, mostly of sizes from 100 watts to 250 watts. These are systematically installed in diffusing globes or reflectors, and both the direct and indirect-lighting systems are employed, the latter usually in conjunction with the former. The main waiting-room, for instance, contains the equivalent of 70,000 cp in concealed lamps with reflectors pointing to the ceiling, in addition to the light given by suspended figures and standards bearing groups of tungsten lamps in diffusing balls. Such a com-

bination of direct and indirect lighting is often very effective and beautiful, while not particularly economical. A somewhat unusual feature of the lighting system is the fact that it is in the main equipped with remote-control switches worked by push buttons from the two information bureaus, so that the lighting can be entirely controlled from these points. The street lighting about the huge building is carried out by clusters of large tungsten lamps inclosed in diffusing balls. These are on special ornamental posts to the number of more than fifty. Altogether this terminal plant is a wonderfully complete example of the finished and thorough working out of a set of problems difficult from the intricacy of the requirements, and the details of the work will repay study on the part of engineers.

THE LAW OF CORONA AND THE DIELECTRIC STRENGTH OF AIR.

The subject of corona formation occupied a fair share of attention at the recent convention of the American Institute of Electrical Engineers. A very good paper on the subject was contributed by Mr. F. W. Peek, Jr. This paper, although perhaps unnecessarily detailed in certain directions, is valuable to engineers, having been written in simple metric units and with the symbols and formulas clearly defined. A large number of experimental measurements are adduced to show that the power dissipated in corona from a three-phase transmission line is directly proportional to the frequency and to the square of the root-mean-square line voltage in excess of a certain critical value. This may be stated in another way by saying that a three-phase line offers negligible dielectric corona leakance until a certain critical star voltage is exceeded. Once this critical voltage is passed the leakage is constant to the voltage excess and proportional to the frequency. Thus, taking a three-phase line of solid wires, each ½ cm in diameter, at usual separating distances, the line, in fine weather, has no corona leakage until the star voltage exceeds in round numbers 50 kv. At, say, 60 kv, the line has a leaking excess star voltage of 10,000 volts and a linear corona leakage corresponding to about 0.4 micromho per kilometer of triple line per cycle per second. At 60 cycles per second this would become 24 micromhos per triple line kilometer, and this would absorb from the excess emf of 10,000 volts a linear triple line power of 2400 watts, or 2.4 kw, per kilometer of triple line.

The paper declares that the loss during storms, and particularly during snowstorms, is markedly greater than during fair weather, although the reason for this circumstance is not very clear. Smoke and sleet are both declared to increase the corona power loss, but humidity is stated not to have any effect. A few years ago Mr. Ralph W. Mershon collected a large number of observations on corona loss with experimental lines near Niagara Falls, and arrived at the conclusion that the humidity of the air had a very decided effect. This humidity effect noticed in the Niagara Falls tests has not been corroborated as yet by any published results, either in the laboratory or in the field. It is possible that in the vicinity of a large waterfall the corona conditions may not be the same as prevail elsewhere, but the discrepancy should certainly be cleared up. The claim that the linear power loss increases directly with the frequency is a very interesting and novel consideration, because it would appear from laboratory measurements that the critical voltage of coronation is only slightly affected by the frequency. That being the case, the reason for the increase of power loss with frequency is by no means self-evident. Another remarkable observation mentioned in the paper is that a strong wind does not appreciably affect the corona power loss. It might reasonably have been supposed that since the loss is due to the charges carried away from the wires convectively, by individual air particles, any wind action which tended to increase the convection of air particles across the surface of the wires would help the dissipation of power. Assuming that the results in the paper are duly corroborated, the fact brought out that the corona linear leakage is, like the conductance of a condenser, a relatively fixed quantity proportional to the frequency, active to all excess voltage above the critical value, makes the matter easily to be understood by engineers.

LUMINOUS EFFICIENCY.

A recent article in these columns by Dr. H. E. Ives gives a deal of interesting information regarding the much-discussed subject of possible efficiencies of illuminants. Dr. Ives points out that the only proper and exact measure of luminous efficiency is lumens per watt. The method of reckoning which has been much used in the past—that of determining the ratio of the visible to the total energy—is obviously improper from the standpoint of illumination merely because the illuminative value of visible energy depends on the luminosity curve of the eye, the red and blue radiations being relatively very ineffective. The specially interesting feature of Dr. Ives' investigation is the enormous efficiency theoretically attainable when the luminous radiation is concentrated in the most intense visible part of the spectrum. The point assigned as the peak of the luminosity curve by Dr. Ives differs slightly from that obtained by some other investigators, being placed by him at 545 $\mu\mu$. Obviously the exact point of highest luminosity depends somewhat on the intensity of the illumination concerned, but it is quite certain that the location for ordinary intensities lies somewhere in the yellow-green, which accounts for the very high practical efficiencies reached by the flaming arcs and by the quartz-mercury tube, both of which have spectra extremely powerful in this region.

As Dr. Ives points out, the most efficient monochromatic radiation is almost exactly in the position of the green mercury line which furnishes a very large percentage of the light of the mercury arc. For light of this wave-length Dr. Ives figures an efficiency of about 65 spherical candles per watt. The highest possible efficiency of white light in a continuous spectrum he reckons at 26 spherical candles per watt, so that the monochromatic source has a prodigious theoretical advantage, and practically a considerable additional gain, from the fact that the temperature required for Dr. Ives' most efficient white light is about 6000 deg. C., quite unattainable with any usable solid material. Unfortunately, as a practical matter, there is also difficulty

with the gaseous sources which give discontinuous spectra, since their energy is scattered over a wide region of the spectrum, so that nothing approximating a really monochromatic source of radiation is actually known. Dr. Ives' suggestion of a standard of luminous intensity, to be reached practically by the use of the yellow-green light of the mercury arc, is a very interesting one, and we trust that he will carry it into practice. Of course, such a standard would involve heterochromatic photometry from the start, but from the present state of experience with the flicker photometer the difficulty is not at all an insuperable one, particularly since such a source could be made to give the high luminous intensity desirable in flicker photometry. At all events, the scheme is well worth trying.

Of course, a monochromatic source is not well adapted for the purposes of general illumination, however useful it may be for specific classes of work, but from Dr. Ives' work, as well as from that of others, it is now pretty evident that any sensational increase in practical efficiency of radiation must be reached by utilizing sources which give discontinuous spectra. How far the efficiency can actually be pushed in such a device remains to be seen, since all known gases and vapors radiate energy, generally in considerable amounts, in the infra-red and other undesirable portions of the spectrum. The helium tube, for example, investigated as a possible standard of light, was found to have a lower efficiency than that of the metallic-filament incandescent lamp owing to the unfortunate distribution of its energy spectrum. Gaseous illuminants, however, do not follow Wien's law, and it may be possible to find methods and degrees of excitation producing improvement in distribution of radiation, and possibly also radiation so distributed as to give at considerable efficiency a better approximation to white light than is usual with discontinuous spectrum. The last chapter on high-efficiency gaseous illuminants is far from being written, and this field should be raked over as carefully as was the field of the rare metals in the beautiful and painstaking researches that led up to the metallic-filament lamp.

THE NATURE OF LIGHT ACTION ON SELENIUM.

It is a well-known fact that the electrical conductivity of selenium is subject to variation under the action of incident light, but the nature and cause of this variation are questions of much complexity. The experimental fact is stated to have been discovered accidentally. Selenium is a metalloidal substance which, in regard to electric conductivity, occupies a sort of middle ground between conductors and insulators. That is, its resistivity is high, but not nearly so high as that of typical insulators, such as glass or porcelain. It was proposed at one time to use a stick of selenium as a very high-resistance leak in submarine-cable testing. In adjusting this leak the resistivity of the selenium was found to vary greatly, and on investigating the nature of this variation it was found that the resistivity was greatly and promptly affected by light, the resistivity being greatest in the dark and least in strong light. With the aid of this principle, grids or cells of selenium have been successfully used in radiotelephony for reproducing speech through a long beam of light. When the photo-electric properties of selenium came to be studied in detail various anomalies were discovered. Thus, the effects varied with the temperature of the selenium, with the magnitude of the impressed voltage, with the previous history of the illumination, and with the intensity of the illumination. Stranger still, samples of selenium were occasionally produced which showed the reverse effect, or increased resistivity under incident light, so that light-negative selenium and light-positive selenium had to be recognized in discussing the effect of light on conductivity.

The *Physical Review* for July contains a paper, by Mr. F. C. Brown, on "The Nature of Light Action in Selenium," in which a hypothesis is advanced for the whole series of phenomena. It is proposed to assume that the substance selenium has three allotropic forms—*A*, *B* and *C*. All these forms are chemically alike, but physically they differ. Allotropic varieties exist, as we know, in many substances, such as oxygen, water, sulphur, etc., so that there is nothing extravagant in such a proposal. In general, allotropes are assumed to be formed of different molecular groupings of like atoms, as, for instance, when molecules of eight, four and two atoms respectively are formed in the element sulphur. These molecules are all alike of sulphur, but most of their physical properties and some of their chemical affinities are different in these different states. It is further suggested that varieties *A* and *C* of selenium have very high resistivity or are almost insulating substances, while variety *B*, on the contrary, has low resistivity or behaves almost like a metallic conductor. When light falls on a mass of selenium it tends to change *A* into *B* and *B* into *C*, the process going on until a certain equilibrium-ratio exists between the respective numbers of such molecules, depending upon the intensity of the incident light as well as on the temperature of the mass. When the light is shut off the *C* molecules tend to return to *B*, and the *B* molecules to *A*, until the original equilibrium-ratio is reached.

Starting from the above assumptions and adding a few more as occasion seems to require, a fairly good case is made for the hypothesis in meeting the experimentally observed facts. That is, among the curves which could be accounted for hypothetically on the above premises some are in accordance with curves derived experimentally. The least that can be said for the hypothesis under discussion is that it offers a promising clew to the elucidation of a very complex state of affairs. We know in general physical chemistry many cases of molecular changes that are either effected or assisted by incident radiant energy. Among these cases are some in which molecular changes of the allotropic type occur in the atoms of one and the same elementary substance under the action of light. The number and variety of these allotropic forms are found to be greater than has been heretofore supposed, and new additions to the list of duly certified allotropes are frequently made. In fact, when energy is added to or removed from a molecular aggregation of a single kind of atoms it is not difficult to understand that changes in aggregation may ensue. If such changes occur, it is very likely that changes will follow in physical properties, such as in electric conductivity.

American Institute of Electrical Engineers Affairs.

At a meeting of the board of directors of the American Institute of Electrical Engineers held Aug. 22 a resolution offered by President Dunn was adopted favoring a larger measure of publicity than in the past for Institute affairs and directing that a résumé of the action of the board be sent after each meeting to the technical press, discretion being reserved to the secretary and president as to what matter shall be included in the résumé. As a result of this wise action we are enabled to present below an account of the many interesting matters upon which the board of directors acted at its recent meeting. This account will also give an idea—for the first time to many—of the broad scope and the importance of the work of the governing body of the Institute.

At the meeting 363 delinquent members were ordered dropped from membership in the Institute, fifty-nine applicants were elected as associates, seventy-nine applicants were enrolled as students, and the following associates were transferred to the grade of member: Messrs. Orin B. Coldwell, Portland, Ore.; Lucius B. Andrus, South Bend, Ind.; Milton W. Franklin, Schenectady, N. Y.; M. de Chatelain, St. Petersburg, Russia; Charles d'Ornellas, Buenos Aires, Argentina.

Petitions were considered from members in Vancouver, B. C., and Lynn, Mass., for authority to form sections, and upon the recommendation of the sections committee the necessary authority was granted.

The report of the committee recommending a change in the method of nominating officers of the Institute was submitted, and in order to secure further consideration it was ordered to be brought up at the October or November meeting.

President Dunn announced the appointment of the Institute committees for the present administrative year. The following is a list of the chairmen of these committees: Executive, Mr. Gano Dunn; finance, Mr. A. W. Berresford; library, Prof. Samuel Sheldon; meetings and papers, Mr. H. W. Buck; editing, Prof. W. I. Slichter; board of examiners, Mr. W. G. Carlton; sections, Mr. Paul M. Lincoln; code, Prof. George F. Sever; law, Mr. C. A. Terry; railway, Mr. Frank J. Sprague; education, Prof. A. S. Langsdorf; high-tension transmission, Mr. David B. Rushmore; industrial power, Mr. W. H. Powell; telegraphy and telephony, Mr. Bancroft Gherardi; electric lighting, Mr. P. Junkersfeld; electrochemical, Prof. Albert F. Ganz; power station, Mr. S. D. Sprong; indexing transactions, Mr. George I. Rhodes; public policy, Mr. Henry G. Stott; intermediate grade of membership, Mr. Percy H. Thomas; historical museum, Mr. T. C. Martin; committee on relations of consulting engineers, Mr. Francis Blossom; United States national committee of International Electrotechnical Commission, Mr. C. O. Mailloux; code of ethics, Prof. George F. Sever.

The following representatives of the Institute were also appointed by President Dunn: On joint committee on engineering education, Profs. Charles F. Scott and Samuel Sheldon; on American Year Book, Mr. Edward Caldwell; on Resuscitation Commission, Dr. A. E. Kennelly; on electrical committee of the National Fire Protective Association, Prof. George F. Sever.

The board elected the following three members of the board of directors to serve upon the Edison medal committee for two years: Messrs Lewis B. Stillwell, H. H. Barnes, Jr., and S. D. Sprong. The board also confirmed the appointment by the president of Mr. Frank J. Sprague and Mr. Schuyler Skaats Wheeler as members of the Edison medal committee for terms of five years.

A resolution was adopted discontinuing the committee on conservation of natural resources and authorizing the president to appoint a committee of seven on public policy. The duties of the committee shall be to report to the board on such questions of public policy as the board shall refer to it and to call the attention of the board to such matters of public policy as the discretion of the committee prompts. The president appointed on this committee Mr. Henry G. Stott, chairman; Messrs. H. W. Buck, John J. Carty, John H. Finney, Charles W. Stone, Calvert Townley and James G. White.

A resolution was adopted declaring it to be the sense of the board of directors that it would be desirable to hold an International Electrical Congress during the Panama Exposition in San Francisco in 1915, such congress to be initiated and conducted by the American Institute of Electrical Engineers under the authority of the International Electrotechnical Commission; and that a committee on congress organization be authorized, the members to be appointed by the president after receipt of such information from the International Electrotechnical Commission as would indicate a disposition on its part to authorize the American Institute of Electrical Engineers to undertake the holding of the congress.

Upon the invitation of the officers of the American Mining Congress, to be held in Chicago Sept. 26-29, 1911, the board authorized the appointment of two delegates to represent the Institute at this congress. The president appointed Messrs. Peter Junkersfeld and William B. Jackson, of Chicago.

A resolution was adopted viewing favorably the project of an Institute trip to Panama in January or February, and the president was authorized to appoint a committee, in co-operation with the meetings and papers committee, to make final recommendations thereon at the October meeting of the board. The president appointed Messrs S. D. Sprong, chairman; Messrs. A. W. Berresford, F. L. Hutchinson, P. Junkersfeld, H. A. Lardner, W. S. Rugg, D. B. Rushmore, Edward Schildhauer and A. M. Schoen.

The question of a suitable acknowledgment of the gift of a bronze bust of von Helmholtz by Mr. Edward D. Adams was referred to the president with power.

The committee appointed at the meeting of the board held at the Chicago convention to canvass the candidates for secretary and report to the board presented a resolution, which was adopted, recommending the appointment of Mr. F. L. Hutchinson as acting secretary in place of Mr. Ralph W. Pope, resigned. Mr. Hutchinson will discharge all duties devolving upon that official under the constitution of the Institute, and is authorized to draw and countersign all checks and drafts in payment of approved bills and vouchers, his services as acting secretary to continue until the end of Mr. Pope's unexpired term, Aug. 1, 1912, or until the earlier appointment of a secretary by the board. The resolution also provided that as the president is about to go abroad to represent the Institute at the meeting in Turin of the International Eletrotechnical Commission and the International Electrical Congress, he be authorized to add a fourth member to the committee on the selection of a secretary and to delegate the chairmanship to one of the present members. President Dunn appointed as the fourth member of the committee, Mr. John J. Carty, and delegated Mr. H. W. Buck to act as chairman.

A resolution was adopted directing that the portion of last year's proposed amendments to the constitution providing for the appointment of the secretary by the board, instead of his election by the membership, be again submitted to the membership for action at the proper time this year. The board also defined the type of secretary it desired as one possessing tact, executive ability and creative force, preferably a man of liberal engineering training and of well recognized standing in the profession of engineering.

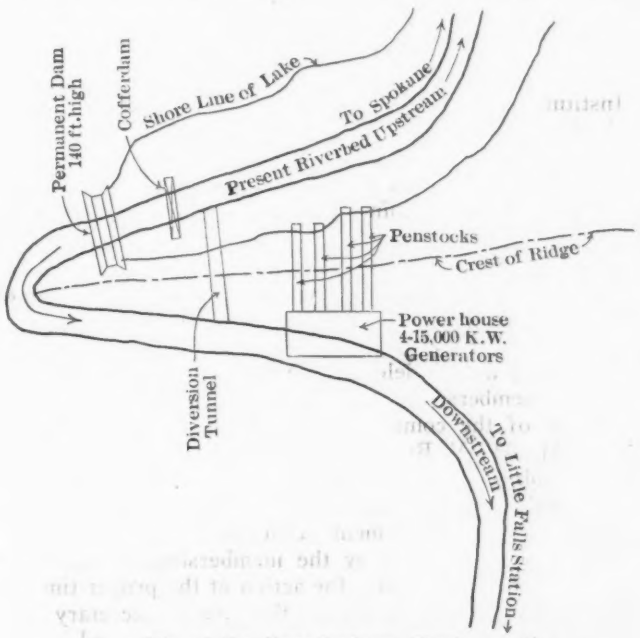
President Dunn announced that during his absence in Europe matters requiring the attention of the president should be referred to Vice-president H. W. Buck. President Dunn sailed from New York on Aug. 26.

Convention of the Pennsylvania Electric Association.

The fourth annual convention of the Pennsylvania Electric Association, the banner geographic section of the N. E. L. A., will take place at Exposition Park, Conneaut Lake, Pa., Sept. 5 to 8, inclusive. The place is a summer resort on the Bessemer & Lake Erie Railroad readily reached by way of Erie or Pittsburgh. The general sessions will begin on Sept. 6, when there will be morning and afternoon meetings, and on the other days but one session will be held, so as to enable the attendants to interchange experiences and enjoy the various entertainments provided. On the evening of Sept. 5 a reception will be tendered to President and Mrs. A. R. Granger, of Chester, Pa. A number of interesting papers have been prepared and much attention has been given to the various committee reports, the overhead-line committee being one of the best committees of its kind in the country. It was this committee which was instrumental in holding up action on the report of the overhead-line committee of the N. E. L. A. at its last convention in New York City. This committee has done much original work and investigation and its report is considered to be very important. Other reports scheduled for presentation will deal with rates, steam heating, lamps, etc. Among the papers which will be read and discussed are the following: *Central Station Versus Isolated Plants*, by Mr. T. E. Spencer, Plymouth; *Electrical Appliances*, by Mr. E. B. Greene, Altoona; *Motors*, by Mr. A. M. Dudley, Pittsburgh. An interesting paper is also promised on *Service Connections*. It is expected that the attendance this year will eclipse that of the Glen Summit meeting last year, which established a record for state meetings. The secretary of the association is Mr. Van Dusen Rickert, Pottsville, Pa.

New Spokane 60,000-Kw Power House.

Excellent progress is being made by the Washington Water Power Company, Spokane, Wash., in the construction of its new 60,000-kw power station at Long Lake on



Site of the New Spokane Plant.

the Spokane River, 4 miles from the present plant at Little Falls. The cofferdam is completed and the work of preparing the river bed for the dam foundations is also finished. Concrete work on the dam will commence shortly. Excavations for the power house and work on the diversion tunnel are also well under way.

The new plant will be equipped with four 22,500-hp turbines, each direct-connected to 15,000-kw, 400-volt, three-phase, 60-cycle generators. The turbines, which will operate under a head of 140 ft., are being built by the I. P. Morris Company, Philadelphia, and the generators by the General Electric Company. Either four 15,000-kw, three-phase or twelve 5000-kw, single-phase transformers will be installed to step up the generator voltage to the transmission level, 60,000 volts.

A short transmission line will be built connecting with the Little Falls station, and eventually a tower line will be constructed north of the river between the new station and the Post Falls station, a distance of about 50 miles.

At the site of the plant the river makes a horseshoe bend in a deep canyon. The hill between the two sides of the bend rises about 250 ft. above the river bed. The power house will be located on the down-stream side of the bend, the four penstocks being carried over the hill. The dam, 140 ft. high, will be built between the canyon walk near the toe of the horseshoe. A cofferdam has been placed some distance above the main dam site, and a tunnel, approximately 18 ft. x 22 ft. cross-section, is being driven through the hill between the channels to carry the river water during the construction work. The lake formed by the dam will extend upstream about 25 miles.

Hydroelectric Development at Healey Falls, Ontario.

The Eastern Power Company, Ltd., one of the subsidiary companies of the Electric Power Company, Ltd., of Toronto, Ontario, has commenced construction work on the development of Healey Falls, on the Trent River, about 5 miles north of Campbellford. At this point there is a head of 76 ft. and the initial installation will consist of two 3000-kw, 6600-volt, three-phase generators driven by 5600-hp turbines, each of which will be fed from a separate steel penstock. The power house is designed to contain two additional main units of the same size, but the third and fourth units will not be installed until the load warrants it. Three-phase transformers will also be installed in the generating station to step up the potential to 44,000 volts for transmission.

The load on the Electric Power Company's system is rapidly increasing at present and the prospects are that by the time the initial installation at Healey Falls is completed, which should be about a year from now, the total capacity of the first two units will have been contracted for. One of the most recent contracts closed is with the Canada Cement Company for the supply of 1000 hp for its Belleville mill located at Point Anna about 4 miles east of Belleville. It is expected that the substation will be completed and the mill electrically operated by the end of this month. When this installation is complete the Canada Cement Company will be taking 4000 hp in all from the Electric Power Company's system in the vicinity of Belleville, the Lehigh mill, requiring 3000 hp, having been connected to the system since the early part of this year. Messrs. Smith, Kerry & Chace, of Toronto, are the engineers of the project.

The Toledo Rate Situation.

In its answer to the petition of the city of Toledo, Ohio, for a court order to enforce the electric-light ordinance recently passed, the Toledo Railways & Light Company attacks the validity of the ordinance and Section 3982 of the Ohio Statutes, which empowers cities to regulate the rate of charge which shall be made for service. Both are alleged to be unconstitutional on the ground that they deprive the company of property without due process of

law and are confiscatory, and that besides they impair the obligation of contracts.

The answer sets forth that the company is furnishing service under individual contracts with consumers, and that its assent on March 30, 1911, to the lighting rate ordinance of July 7, 1907, made a contract between the company and the city which is still valid. This ordinance, it is claimed, fixed the rate for a term of five years after its passage at 9 cents per kw-hour with a 10 per cent discount for the payment of bills by the tenth of the following month. The new ordinance is held to be illegal because this one has not been repealed.

Of its 4000 consumers under contract at the rate established by the former ordinance 2000 use an average of less than 20 kw-hours per month and 1000 use less than 10 kw-hours per month. The average used by all is 23 kw-hours per month. The actual cost of furnishing service for lighting to citizens, the company says, is $25 a year and the cost of furnishing to minimum users is $17 per year. Should the company be compelled to furnish service at the rate established by the new ordinance, 8 cents with a discount of 1 cent, the company claims that it would lose $25,000 per year, and then if it should be compelled to carry out its contracts with consumers having a lower rate than 8 cents it would lose $50,000 a year. It is probable that this case will be carried to the higher courts if the position of the lighting company is not sustained by the lower tribunals.

Massachusetts Legislation Affecting Central Stations.

The annual meeting and dinner of the Massachusetts Electric Lighting Association was held at the Point Shirley Club, Winthrop, Mass., Aug. 16. It was the largest gathering of the association in ten years, fifty-five members being present, representing practically all the important companies in the State. The meeting was called to order by Mr. Charles L. Edgar, president, and the report of the executive committee was read by the secretary, Everett W. Burdett, Esq. In this report were outlined the important measures passed by the recent Legislature of Massachusetts that had special reference to electric-lighting interests and also the bills which were introduced but which were defeated or modified before enactment.

The report stated that although the Legislature of 1911 was the most radical of any in the history of the State and seemed to be willing to do damage, yet nothing inimical to electric-lighting interests was finally enacted. Several highly objectionable measures were adopted in one branch, but defeated in the other. Furthermore, the recent Legislature enacted several measures that are very helpful to electric-lighting interests, of which the law relative to the transmission of electricity and that relative to the confirmation of defective locations were most important.

The first of these acts is a careful revision of the laws relative to the erection and maintenance of poles and wires and the construction of conduits and cables in public streets. It clears up many points hitherto obscure and enables the companies hereafter to obtain and hold valid and effective locations instead of maintaining doubtful and often unlawful obstructions in public ways.

The other act points out a method by which all locations actually in use which have ever been granted by aldermen or selectmen, no matter how defective, may be made valid. The provisions of this law are briefly these:

A location actually granted by public authority and in use may be confirmed and ratified by the present owners filing before Jan. 1, 1913, with the city or town clerk a map showing the exact location and nature of the structures, together with a memorandum of the dates of the grants of locations therefor. These are to be kept with the records of original location for poles and wires.

It is suggested in this connec[illegible] that when asking for locations, etc., each company act in c[illegible]ration with other wire-using interests in the same local[illegible] particularly the telephone company. By this means a uni[illegible]m practice can be established in each city and town. It is further suggested that each company have blank petitions and orders printed for its own use of the same size as those used by the other companies in the same localities and that the local authorities be requested to use these forms in all cases. In a circular issued by the association a form is suggested for petitions and for orders.

A proposition urged by Governor Foss, to do away with the several existing public-service commissions and constitute a single commission with the authority and duties of all, failed of being adopted. While the public-service companies did not intermeddle with the matter, the result seems to show that the plan has little favor with legislators and the people at large.

The effort to authorize cities and towns to maintain underground municipal conduits and to compel private companies to use them was also ineffective.

By agreement of all parties in interest the Boston underground wire act was amended and the transmission of high-tension currents through that city except in underground ducts forbidden. Likewise by agreement, an underground wire act for the city of Beverly was enacted.

The effort to forbid the use of demand indicators and the employment of differential rates of charge resulted in the reference of the subject to the Gas and Electric Light Commissioners for investigation and report to the next Legislature.

No radical measures on the subject of taxation were enacted, though some were proposed and advocated. An important act relative to payments to employees for personal injuries during employment, and the prevention of such injuries, was approved July 28 and goes into effect next year. It does not deprive employers of the right which they now have to defend injury cases, but it does deprive them of three important defenses which they now have, viz.: (1) That the employee was himself negligent; (2) that the injury was caused by the negligence of a fellow-employee; (3) that the employee assumed the risks of the employment. If the employer does not wish to rely upon his legal rights, as above stated, he may insure his liability to pay the compensation to employees provided in the act either in any stock or liability insurance company or in the Massachusetts Employers' Liability Association, created by the act. This latter association is to have fifteen directors, appointed in the first instance by the Governor and afterward elected by the subscribers to the association, namely, employers. The act provides an elaborate schedule of payments to an injured employee of much the same character as the schedules in accident insurance policies. But if an employee is injured as a result of his own "serious and wilful misconduct" he is not entitled to compensation, while if he is injured by reason of the serious and wilful misconduct of his employer the compensation is doubled. An employee cannot waive his rights to compensation under the act, but is held to have waived his rights under the common law unless he gives notice of his intention to rely upon them instead of upon the provisions of the act.

The act creates what is called the Industrial Accident Board, of three members appointed by the Governor, with salaries of $6,000 each, with $500 additional for the chairman. If the new insurance association, or a liability company, as the case may be, and an injured employee cannot reach an agreement as to compensation for an accident, the board is to provide for an arbitration committee of three, of which one of its own members is chairman. The decisions of such committees have the force of decrees of the Superior Court. All employers are required to keep records of all injuries to employees, whether fatal or other-

wise, and to report the same in writing to the Industrial Accident Board within forty-eight hours.

The following analysis of legislation of 1911 affecting lighting interests, in addition to that already given, accompanied the executive committee's report and was in its main features as follows:

Authorizing the town of Danvers to distribute electricity in North Redding and Middleton. This act does not invade, but adopts, the principles of the general municipal ownership statute and affects no company except the Middleton Electric Light Company.

Requiring the burial of certain wires in the city of Beverly. This act is similar to those relating to other cities and is satisfactory to the Beverly Gas & Electric Company.

Requiring the Gas and Electric Light Commissioners to include the names and addresses of officers and directors in their annual report of lighting companies.

Providing that no electric light, heat or power company shall, without the Legislature's consent, transfer its franchise, lease its works, or contract with any party to carry on its works except when so authorized by the Gas and Electric Light Commissioners pursuant to a previous law.

Requiring that, beginning January, 1912, and for five years thereafter, the commissioner of wires shall prescribe 3 miles of "main streets" outside sections of Boston already provided for and 2 miles of "side streets" within which wires shall be placed underground or removed. "Main streets" are defined to be streets on which trunk lines of wires or cables are located, and "side streets" those which run into such main streets. The act, after long negotiations, was finally enacted with the assent of all parties interested.

Providing that no wires for the transmission of electricity at more than 5000 volts alternating or 10,000 direct shall after June 30, 1913, be maintained in Boston except under ground.

Modifying the existing law relating to political advertisements, which forbade any lighting company or a trustee owning a majority of its stock contributing to the prevention or the promotion of any candidate's nomination or election for public office, or the interests of any political party, or the vote on any measure submitted to the voters. By the above act such corporations or their trustees may publish paid advertisements, with the word "advertisement" attached, when under a referendum the question of acquiring any of the property or business of the company is involved. The name of the corporation must appear as a signature.

Providing that money lost in cash-recording meters by fire shall be the loss of the lighting company.

Providing that the towns of Wakefield and Reading, each of which has a municipal electric-lighting plant, may supply electricity, each in the other town, and that Wakefield, which has also a gas plant, may supply gas in Reading.

Amending the existing law relative to stationary engineers and firemen in several particulars.

A by-law was amended by the association making the membership fee $20 for each company and the basis for levying assessment 1 per cent of the "balance of electric manufacturing account" of each company, as shown by the report of the Gas and Electric Light Commission, the maximum assessment for any company to be $3,500. Hitherto the assessments have been based on the capital stock and bonds of the member companies, and the maximum was $3,000.

The following officers were re-elected for another year: President, Mr. C. L. Edgar, Boston Edison and amalgamated companies; vice-president, Mr. C. F. Prichard, Lynn, Beverly and Gloucester companies; vice-president, Mr. Albert F. Dow, Fall River Electric Light Company. Other members of the executive committee: Messrs. Frederick S. Pratt, Lowell Electric Light Corporation and Edison Company of Brockton; Robert W. Day, United Electric Light Company, of Springfield; Arthur E. Childs, Ayer, Clinton, Leominster, Milford, North Adams, Northampton and Spencer companies; Alfred B. Tenney, Fitchburg, Haverhill, Malden, Salem and suburban companies; George T. Dewey, Worcester Electric Light Company; Joseph W. Stevens, Greenfield Electric Light Company.

Public-Service Commission Law of Nevada.

Under the authority of the new regulative law the Public Service Commission of Nevada has prescribed a uniform system of accounts for electric utilities and rules and instructions for gas and electric service.

The public-service commission law makes the Railroad Commission of the State ex officio a public service commission for the regulation and control of commercial, private or municipal heat, light, power, water and sewerage plants. The act was approved on March 23, 1911.

Nothing in the act is to be construed as vesting judicial powers in the commission or as denying to any one the right to test in a court of competent jurisdiction the legality or reasonableness of any final order made. Reasonably adequate service is required and reasonable and just charges must be made. The commission may in its discretion value the property of the companies and in any investigations for this purpose may avail itself of information contained in assessment rolls of counties and public records of various branches of the State government. Uniform accounts shall be kept and the commission has the right to examine all records. Failure to report for a period of thirty days to the commission in accordance with the law makes any officer, agent or person subject to a fine of not less than $100 or more than $500. Each day's refusal shall constitute a separate offense. Schedules shall be filed with the commission. While rebates or discriminations are made unlawful, existing contracts shall not be suspended or invalidated. An expert engineer may be employed at a salary of $3,600 per annum and necessary traveling expenses. The commission may employ such other experts and assistants as it may deem necessary and fix their compensation. Disobedience to a subpœna commanding attendance before the commission shall be deemed a contempt of the court and punished accordingly. The commission shall have power to substitute just and reasonable rates for any that are found to be unreasonable or unjustly discriminatory.

In adopting rules and instructions for gas and electric service in the State the commission gave consideration to the rapidly changing conditions to which the electrical industry is subjected. The accuracy of an electric meter shall be determined from readings taken at normal operating load and at 10 per cent of the rated capacity of the meter. The normal load, expressed in percentage of the total connected load or installation, shall be classified as follows: Class A, residence and apartment lighting and elevator service, 40 per cent; Class B, factories and general store lighting and power, 50 per cent; Class C, churches, offices, theaters, clubs and restaurants, 60 per cent; Class D, saloons, pumps, air compressors and ice machines, 70 per cent; Class E, sign and window lighting, blowers and moving-picture machines, 100 per cent. Two per cent is the permissible limit of error. In addition to the installation test and the yearly test of each meter, it is provided that each company shall make a test upon request of a consumer, provided the request is not made more frequently than once in six months. The commission will make tests upon application and payment of a fee of $1.50, to be met by the consumer if the meter is correct or slow within the allowable limit or by the company if the meter is fast beyond the limit fixed. Each company is required to maintain a record of all interruptions of service. Each company supplying energy on constant-potential systems

shall maintain a standard average voltage as measured at any consumer's cut-off, which shall remain constant from day to day and vary during any one day by an amount not more than 6 per cent of the minimum value. It is probable that a closer regulation may be required in the future. The commission recognizes that it may be some time before all the companies may find it possible to meet these requirements and in such cases conference is to be held with the commission. Companies are to inform consumers upon request as to the specific conditions under which efficient and economical illuminating service may be secured from the system. Where local conditions would make a literal enforcement of the rules an unwarranted burden to a utility or consumer, application should be made to the commission for a modification. The rules are to go into effect on Sept. 3.

The uniform classification of accounts for electric utilities prescribed by the Nevada commission says it is desired that the companies conform their accounts to the system at their earliest possible convenience. In order that the system may meet in a most satisfactory manner the needs of the electric interests, consistent with the requirements of the law, it is urged that all companies which are unable to conform to the accounts communicate with the commission, stating their reasons and explaining how full a compliance can be made. A note under the operating expense account says that in case any utility finds it impossible or impracticable to keep its accounts with the detail prescribed, it should petition the commission for authority to consolidate any two or more accounts, accompanying the petition with a statement of the reasons for its position. Operating expenses are divisible into two classes, operating and maintenance. Operation is stated to mean the "use" of the property and includes labor, materials and supplies and expenses, but excludes all maintenance items. Maintenance is stated to mean "upkeep," and should cover all expenditures for ordinary repairs, renewals or replacements of property resulting through wear and tear, or through those casualties which are incidental to the nature of the operation and which are necessary in order to keep up the productive capacity of the plant to its original or equivalent state of efficiency.

New York Commission News.

The Public Service Commission, Second District, has received a petition from the Long Island Lighting Company for permission to construct necessary poles and appliances for the furnishing of electricity in the town of Smithtown, Suffolk County, and authority to issue $90,000 in 5 per cent twenty-five-year first-mortgage bonds under an existing mortgage; an application from the Keeseville Electric Company for permission to construct a transmission line and exercise franchises for the supplying of electricity in the towns of Jay, Essex County, and Ausable, Clinton County, and application from the Bolton Light & Power Company asking authority to issue $12,500 common capital stock.

A complaint has been received from Attorney Thomas M. Losie, of the town of Elmira, against the maintenance charge exacted by the New York Telephone Company to its patrons in that town. The complainant states that the telephone company charges a flat rate to its subscribers within the city limits of Elmira, but patrons residing beyond the city limits are required to pay a maintenance rate over and above the regular rate for each fourth mile or fraction thereof distant from the city line. Inasmuch as the service rendered the patrons in and outside the city limits is the same, complainant alleges that discrimination exists. He also alleges that the city limits are not reasonable and equitable starting points for an extra maintenance rate for the reason that the city line has nothing whatsoever to do with telephone service or the cost of same, and for the further reason that the past experience of the company has not proved that it is necessary for it to make such extra charge. Complainant also contends that the New York Telephone Company is writing four-party and two-party residence service contracts at different rates, and that both services are identical for the reason that the company will not be able for a long period of time to operate four-party lines. The commission is asked to enter an order directing the telephone company to discontinue its maintenance charge in so far as the same relates to the district known as the West Water Street district and Elmira Heights in the town of Horsehead. The complaint has been served upon the company and an answer will be filed within twenty days.

Ohio Commission News.

The Gratiot & Brownsville Telephone Company has filed a complaint with the Ohio Public Service Commission against the Brownsville Farmers' Telephone Company, both of Muskingum County, in which it says that there is no public need for another system in that community and that it would result in a duplication of service. The Brownsville Farmers' Telephone Company has filed an answer to this complaint to the effect that the proposed new service will be of very material benefit to the people and stating that the service of the other company is not up to the standard. It also states that its business was begun before the enactment of the new public utilities law and that its construction work has been under way for some time. This is the first case brought before the commission under which it must either issue or refuse a certificate of public necessity to a company desiring to build a system where one is already in use.

Massachusetts Commission News.

The Dedham & Hyde Park Gas & Electric Light Company has petitioned the Massachusetts Gas & Electric Light Commissioners for permission to issue additional capital stock to the amount of $14,200, to consist of 284 shares of the par value of $50 each, to be issued at $60 per share. The purpose of the increase is to pay for extensions and additions to its mains, services, etc., and to provide for further extensions and enlargements. The present capital stock is now fixed and limited at $141,750.

The Ware (Mass.) Electric Company has petitioned the commission for permission to issue $40,000 new capital stock, in 400 shares of the par value of $100 each. The purpose of the desired increase is to pay floating indebtedness for new constructions, extensions and permanent improvements already made and for further development of the property. The present capital stock of the company is $40,000.

The commission on Aug. 22, 1911, approved the Weymouth Light & Power Company's petition for the approval of an issue of new capital stock of the par value of $210,000 on account of additions to plant. At the same time it annulled the order issued Feb. 6, 1903, which approved an issue of $25,000 of capital stock and $50,000 of first-mortgage bonds. The proceeds of the new issue will be to pay for additions to the company's plant. On Feb. 6, 1903, the board approved an issue of 250 shares of the par value of $25,000 and of bonds to the amount of $50,000. The proceeds of 110 shares of this stock were to be applied to the cost of installing new steam and electrical equipment, the proceeds of 140 shares were for the purpose of canceling an equal amount of coupon notes outstanding, and the

bonds were for refunding an equal amount of bonds. At that time the company had a capital stock of $50,000, bonds of $50,000 and coupon and other notes of $54,500. No part of the stock or the bonds approved in 1903 has ever been issued, but extensive additions have been made to the company's plant. The expenditure for this purpose for the year ending June 30, 1911, has been about $80,000. The bonds and all but $7,000 of the coupon notes have matured and been paid. The board specifies that 1700 shares of the new stock shall be applied to the payment of an equal amount of the company's obligations represented by promissory notes outstanding June 30, 1911.

Wisconsin Commission News.

On Aug. 15 the Railway Commission served notice on the Milwaukee Electric Railway & Light Company, the Menomonie Light & Fuel Company, of Menomonie, and the Eastern Wisconsin Railway and Light Company, of Fond du Lac, that after the expiration of ten days from the time of serving the notice the commission will proceed to investigate the refusal of the above companies to comply with the orders of the commission relative to rates and service. The commission states that it has made repeated investigations of the service furnished by these corporations, has found that such service is not in accordance with law, and has issued orders that the faults be corrected and the law regarded. To these orders the corporations have paid no heed. This condition of affairs has existed long enough in the mind of the commission and it will endeavor to make an example of the delinquent corporations. The results of the investigations made within the next ten days will determine whether or not proceedings will be begun to enforce the penalty as provided in the statute for non-compliance with the commission's orders.

The commission has authorized the La Crosse Independent Telephone Company to issue 400 shares of preferred stock, of the par value of $50 each. This stock is to be sold at par and for money only. Because of its rapidly increasing business the company has found it necessary to build a new and larger exchange and to increase its equipment and extend its toll service. The proceeds to be derived from the sale of the stock are to be used toward paying for the cost of laying underground conduit and cable to the new building and for extending and improving the city and rural systems.

CURRENT NEWS AND NOTES.

TECHNICAL NOMENCLATURE OF LIGHTING.—The International Photometric Commission has appointed a committee to consider a proposal by Prof. A. Blondell relating to the nomenclature of lighting. The committee includes Brodhun, of Germany; Laporte, of France, and Patterson, of England.

* * *

JOVIAN HEADQUARTERS TO ST. LOUIS.—The headquarters of the Sons of Jove, together with all records and paraphernalia of the order, have been removed by Secretary E. D. Strickland from the former offices in the Monadnock Block, Chicago, to new quarters at 1412 Syndicate Trust Building, St. Louis, Mo. Mr. Ell C. Bennett, manager of the *Electric St. Louis Magazine*, will devote part of his time to the order in that city. An enlarged issue of the *Jovian Bulletin*, the official organ of the Sons of Jove, is planned and a campaign to stimulate interest will be begun.

* * *

ELECTRICAL REPRESENTATION ON INTERNATIONAL PHOTOMETRIC COMMISSION.—At a meeting of the International Photometric Commission recently held in Zurich it was voted to admit to membership men identified with the electrical science and industry. The commission, which was founded at the time of the International Gas Engineering Congress held in Paris in 1900, has heretofore directed its work more particularly to the needs of the gas industry. The proposition for electrical representation came from Herr Dettmar, secretary of the German National Electrical Association.

* * *

INTERNATIONAL TELEPHONE LINES IN EUROPE.—A bill concerning the establishment of telephone communication between Milan, Zurich, Basel, Frankfort and Berlin has been passed by the Italian Parliament. The proposals for the new lines have to be ratified by the authorities in Germany, Italy and Switzerland, but this is said to be a mere matter of form, and construction work may soon commence. The shortest course between the different places will be followed, railway lines and highroads not to be considered in routing. The lines from Milan to Basel and from Milan to Basel and Frankfort will probably pass through the Simplon and go via Lausanne, whence the shortest route will be taken to Basel.

* * *

AN AEROPLANE-PROPELLER TEST PLANT.—A 75-hp adjustable-speed motor is used by the Worcester Polytechnic Institute for testing aeroplane propellers in its new experimental plant. The propeller is mounted at one end of a centrally pivoted 160-ft. beam and, driven by the motor, propels the beam against the adjustable resistance interposed by paddles which can be let down into the water of the lake in which the plant is mounted. To simulate flight conditions further, a second motor will be installed to drive the beam at a tip velocity of 60 miles per hour. The thrust exerted by the aeroplane propeller and the power taken to drive it under various conditions are measured by recording instruments on the rotating beam.

* * *

ELECTRIC IRON MELTING IN SWEDEN.—A report on experiments in the reduction of iron ore in electric furnaces at Trollhättan has been made by the Association of Swedish Iron Manufacturers, which, with government support, carried on the work. The results showed a reduction of 2.7 tons of pig iron per yearly electrical horse-power, but it is thought this can be increased to 3 tons. The consumption of carbon electrodes was 22.6 lb. gross, or 11.6 lb. net, per ton of iron, and 816 lb. of coal were consumed per ton. On the basis of selling price of product the experiments were self-supporting. In view of the successful results the government has proposed to raise the price of electrical energy to $13.40 per kw-year; the ironmasters, however, claim that the business will be unprofitable at any rate exceeding $10.72 per kw-year.

* * *

CHICAGO SANITARY DISTRICT EMPLOYEES' SALARIES HELD UP.—As a result of the political deadlock between the Harrison and anti-Harrison members of the board of trustees of the Sanitary District of Chicago the July payroll of the district's employees, totaling $53,645, still remains unpaid. President Smyth, the recently elected Harrison successor of Mr. Robert R. McCormick, a month ago ordered discharged thirty-seven appointees of the former administration, among them several electrical employees. The anti-Harrison members blocked this action and insisted that these men continue to work. Meanwhile the president has held up the payroll of the entire body of employees, declaring illegal any payment to the men he discharged. Discipline of the district's staff is said to have suffered, and the employees are badly in need of their salaries, some having fallen into the hands of loan sharks to tide over their necessities.

Colorado Sons of Jove.—The Sons of Jove of Colorado gave a theater and picnic party at Denver on the afternoon and evening of Aug. 24, part of the object being to add to the fund for the entertainment of visitors to the Jovian National Convention in Denver, in October. Tickets to the value of $1,500 were sold.

* * *

Calorific Power Standard for Illuminating Gas.—The International Photometric Commission has recommended that the calorific value of gas shall express also its illuminating power. This is the result of an investigation by a committee, of which Dr. Burite, of Germany, was the chairman, which reported that the calorific power expresses accurately the energy of gas, and that "the determination of illuminating power, in the actual conditions in which gas is used, ought henceforth to be regarded as useless."

* * *

District Electrical Service in California.—The Pacific Gas & Electric Company, of San Francisco, supplies electrical service to 158 cities and towns in twenty-six counties in California having an aggregate population of 1,089,790, or, without San Francisco, Oakland and Berkeley, a population of 367,790. The area covered is half that of New England. The company employs 3500 men and has eleven hydroelectric and three steam-driven plants and eighteen gas works. Gas is supplied to a population of 988,900.

* * *

Los Angeles Electrical Festival.—The electric companies of Los Angeles, Cal., have organized for the purpose of holding an electrical exposition at Fiesta Park for two weeks, Nov. 25 to Dec. 9. An executive committee, headed by Messrs. H. B. Woodhill, C. S. Walton and J. E. McDonald, has been appointed to formulate plans. Eastern companies will be invited to exhibit. The site selected includes about 90,000 sq. ft. and the display is estimated to cost $100,000. Mr. Woodhill is chairman of the committee.

* * *

Colorado Electric Club.—On Friday, Aug. 24, the Colorado Electric Club opened its 1911-12 season, by a dinner at El Jebel Temple to Hon. R. W. Speer, Mayor of Denver, upon occasion of his return from a European trip in company with the Bureau of University Investigation of the Boston Chamber of Commerce. Mayor Speer has been appointed chairman of the sub-committee of the Bureau on Municipal Affairs, on which subject he gave a talk. Hon. Willis V. Elliott introduced the speaker. The occasion formed a part of an advance publicity campaign for the Colorado Electrical Show, on Oct. 14-21, at the Denver Auditorium.

* * *

To Investigate Chicago Drainage Canal's Effect on Lake Michigan's Fruit Crop.—Official recognition is now to be accorded the claims put forth by Michigan fruit growers that the opening of the Chicago Drainage Canal by withdrawing water at the lower end of Lake Michigan causes cold currents to flow down from the Straits of Mackinac, affecting the climate of Michigan, Illinois and Wisconsin fruit belts and damaging crops. In accordance with a provision in the Rivers and Harbors bill of the last Congress Col. C. M. Townsend, of the United States Engineering Corps, and a staff of assistants on board the steamship *Hancock* plan a complete investigation of the temperatures, currents and depths of Lake Michigan, which will be compared with the results of earlier investigations. A few minutes' exercise with pencil and paper reveals the interesting fact that the southerly current in the lake due to the quantity of water being taken by the Drainage Canal reaches the velocity of about 0.000085 mile per hour, at which rate the time taken by a given gallon of water to flow from Mackinac to the Chicago entry would be about 4,118,000 hours, or 400 years —probably time enough for it to become well acclimated to the few degrees' difference in temperature between the ends of the lake.

* * *

The Horn Lightning Arrester.—A Nevada mining newspaper furnishes the following not unintelligent account of the horn lightning arrester: "While waiting for supplies to finish up his job of connecting the substation of the power company with the machinery at the Nevada Wonder shaft Mr. Halpenny has kept busy making improvements about the plant. The most conspicuous and probably the most important job is the installation of a lightning arrester. It is a curious thing in appearance and anyone with half a mechanical eye could tell that it is a lightning arrester, because it couldn't possibly be anything else. It is mounted on staging at the rear of the power station and consists of a curious system of wiring and six long, slightly curved pieces of small iron pipe. The idea is, as nearly as the lay mind can grasp it, that when a bolt of lightning attaches itself to the wire it will follow it till it finds a good jumping off place. These great horns of iron pipe, pointing toward the sky, are good conductors as far as they go, and when the lightning comes along it follows the line of least resistance. Three of the horns, near their bottoms, are near but do not touch those connected with the three main lines. The current or lightning bolt jumps across this space, follows the detached gas-pipe horn upward toward its tip, and, having no other place to go, just goes out into the sky, whence it came."

* * *

Electric Motors for Logging.—Donkey engines driven by electricity are now used in logging operations in the Spokane (Wash.) district and it is planned to extend their use to forests in other parts of the Pacific Slope and intermountain country. The first electric "donkey engines" to be used in the Northwestern forests, at Potlatch, Idaho, are built on lines originated by Mr. E. P. Barry, electrical engineer, of the Potlatch Lumber Company, who for experimental purposes converted a steam donkey machine by gearing the motor to the position formerly occupied by the boiler. A motor-driver compressor supplies air for the signal whistle. The apparatus, specially built for severe service, is of 150 hp, three phase, 550 volts, 60 cycles, 435 r.p.m., equipped with a current-limiting device, and handles an average of 35,000 ft. of logs a day. Ten engines to handle from 300,000 ft. to 500,000 ft. a day will be installed to replace steam engines. In the latter case the transmission lines will always be in the rear of the logger and consequently built over logged-off land. A portable substation consisting of a three-phase transformer of 150-kw capacity will be placed at a convenient point for stepping down the voltage from 11,000 to 550, a steel-armored cable running to the motor on the logger, this cable being in sections to allow the logger being warped out up to a distance of 1800 ft. from the substation. Mr. Barry is also interested in the electrification of logging roads. While, he says, the first cost of an electric road is high in comparison with a steam road, varying from two and a half to three times in initial outlay, owing to the expense of poles, insulators, trolley lines, transformers, rail bonding and the labor involved in installing the apparatus, the maintenance costs are much less. Delays through break-downs have decreased one-third since adopting electric drive on a road previously operated by steam. The average cost of electric locomotives is from $11,000 to $16,000, dependent on size and capacity, about the same as for steam locomotives. A great advantage of electric drive is, he says, the fact that through it the large quantities of fuel now burned as refuse by every lumber mill can be utilized. Many thousands of horse-power are thus wasted every year.

NORTHWESTERN TERMINAL IN CHICAGO.

Lighting, Heating, Ventilation, Motor Applications and Various Miscellaneous Utilities.

IN a preceding article the power plant and electrical distribution of the new passenger terminal of the Chicago & Northwestern Railway Company in Chicago were described at some length. It is the present intention to describe the interesting and extensive application made of the electrical and mechanical energy obtained from the power plant. It may be well to preface the account by saying that the terminal covers three full city blocks bounded by West Lake, North Canal, West Madison and North Clinton Streets, exclusive of a triangular block on the north side of West Lake Street and also bounded by Milwaukee Avenue and North Clinton Street. This triangular block contains the power plant. Fig. 2 is an exterior view showing the imposing façade of the main building on Madison Street. This Madison Street front is 320 ft. wide, while the terminal extends north 1450 ft. to the tip of the triangular lot, marked by the power-house chimney. The terminal tracks are elevated and the cross-streets, West Washington Street, West Randolph Street and West Lake Street, go beneath the tracks. The exterior walls of the main building are of granite and are continuous with the inclosing walls of the train shed, which are of gray brick. This gives to the entire terminal the external appearance of one mammoth building. After being under construction for two years and a half the terminal was put into service on June 3, 1911. It is very handsomely and completely equipped. The expenditure for the power plant and appurtenances installed in this building was alone $1,500,000.

Fig. 1—View in Main Waiting-Room, Showing Manner of Lighting Vaulted Ceiling.

GENERAL LIGHTING FEATURES.

Tungsten lamps are used throughout for the lighting of the main building. With but few exceptions the lamps are of the 150-watt or 250-watt size. The public space on the ground-floor level and the main waiting-room on the track-elevation floor are two of the most brilliantly lighted rooms in any railway terminal or public institution anywhere. As shown in Fig. 3, the fixtures in the public space on the ground floor are extremely simple. They consist of white opal globes 18 in. in diameter, each one in the ceiling of each bay containing four 100-watt lamps. These lamps are arranged on two circuits so that 50 per cent of the lighting can be utilized if desired. In addition to this, various sections of the room can be turned on or off as needed.

ILLUMINATION OF MAIN WAITING-ROOM.

Indirect lighting is used to a great extent in the main waiting-room, shown in Fig. 5. Along the ledges running along the north and south sides of the room at an elevation of 46 ft. above the floor are placed concealed lamps. The ledges are 10 ft. wide and each one is divided into seven spaces by the arches supporting the barrel roof, in the manner shown in Figs. 1 and 5. In each of these sections there are thirty 250-watt lamps, each with an Alba glass shade set at the proper angle to obtain the greatest amount of reflected light from the ceiling. Lamps and globes, shown in Fig. 1, are mounted on a special frame, being adjusted so as to vary the angle at which the light strikes the ceiling, which at its highest point is 82 ft. above the floor. On both ledges there is a total of 420 lamps, or the equivalent of 70,000 cp. It should be explained that the ceiling is made of guastavino to give a soft, even distribution over the entire surface and is very effective and pleasing.

Supplementing the indirect lighting of the main waiting-room there are splendid fixtures, as shown in Figs. 1 and 5, hanging from the soffits between the columns of both the north and south sides under the ledges heretofore mentioned. In addition to this the room is supplied with eight

Fig. 2—Exterior View of Northwestern Railway Terminal in Chicago.

handsome standards. Four of these, as seen in Fig. 5, are at the west end of the room and there are four others at the east end. A nearby view of one of these standards is shown in Fig. 4. Each of the standards and lighting fixtures supports lamps giving about 1880 cp, the lamps being 100-watt and 150-watt in size.

INDIRECT LIGHTING AND SPECIAL FIXTURES.

Generally speaking, the lighting throughout the terminal station is direct. However, special treatment has been given to the women's waiting-room and the women's tea-room (Fig. 6) and to the dining-room (Fig. 7). In each of these cases indirect or reflected lighting is used, the pictures indicating clearly the kind of fixtures employed. In the barber shop on the track-level floor indirect lighting has been provided with the addition of direct lighting for the mirrors, as well as lamps in brackets along the wall. The arrangement here is such as to keep the direct rays of light out of the line of vision of any one in the barber chairs. Fig. 8 shows the simple type of fixtures adopted for the train concourse. Where direct lighting is used Alba globes or Alba deep-bowl shades are employed with but few exceptions, such as in the corridors in the office portion of the main building, where the diffusing Alba shade is installed.

Special fixtures, in wall recesses, covered with a glass front and near the floor, have been designed and installed for throwing light directly on stair landings. Since the

Fig. 3—View Showing Lighting of Public Space on Ground-Floor Level.

station has been opened it has been found that this lighting is quite sufficient without the use of brackets to illuminate all of the minor staircases throughout the building. Special fixtures were also designed for lighting the basement, the baggage storage-room under the train concourse and the incoming baggage-room on the ground-level floor. These are made up with a specially designed shock absorber, plain conduit stem with spun-zinc canopy and cast-zinc weatherproof socket, each 250-watt lamp being equipped with an Alba shade with but few exceptions. A single unit was placed in each bay as near as the steel construction would permit, and this arrangement has been so carefully worked out as to give an even distribution of light over the entire floor space.

Many of the main-building fixtures are notably handsome, as may be judged by the newel-post lamp support shown in Fig. 9. Here the uprights are of bronze with characteristic terminal ornamentation in relief, while the bowl is of alabaster. The latter contains three 60-watt lamps.

REMOTE CONTROL.

One feature of the lighting to be noted particularly is that in all large spaces the circuits are operated by remote-control switches brought into action by momentary-contact push-button switches located in the two information bureaus, one being in the public space on the ground-

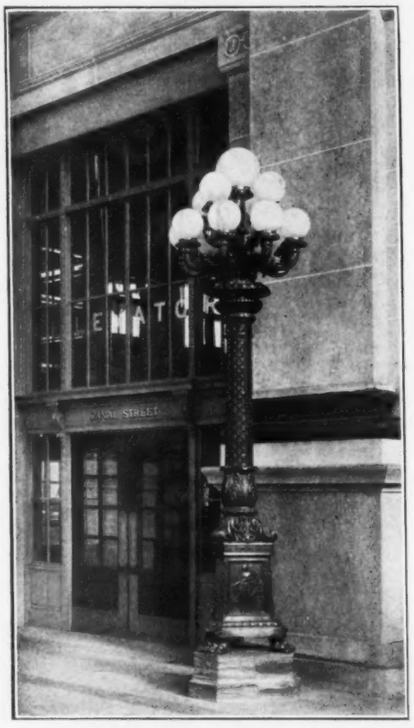


Fig. 4—One of the Bronze Lamp Standards in Main Waiting-Room.

floor level and the other in the main waiting-room on the floor above. From these points are controlled the lighting in the main public space, the street lamps about the building, the lamps in the main waiting-room and in the concourse and the end of the train sheds between the concourse and track bumpers. Fig. 10 shows a typical cut-out cabinet, this one being in the train concourse. It may be mentioned here that the lighting of the main waiting-room is controlled in sections, so that a number of combinations for partial lighting may be obtained.

The lighting of the under-track portions of the terminal is the same as that of the basement of the station building, 250-watt units with Alba shades being used, except in such places as carriage driveways and automobile spaces, where 100-watt lamps are employed. In the subways or street crossings under the elevated tracks 100-watt lamps with shades and specially made guards are used. These guards, hinged at the top and fastened at

the bottom with a small Yale lock, serve the double purpose of preventing lamps from being stolen and avoiding breakage by teamsters' whips.

SPECIAL AND STREET LIGHTING.

Special lighting provision has been made in the post-office substation, on the street level of the terminal, north of Washington Street. The main wagon drive is illuminated by about thirty-five Cooper Hewitt mercury-vapor lamps. In the post office proper the general illumination is carried out in the same manner as in other under-track portions of the terminal, but in addition there have been provided over the sorting cases small 12-volt tungsten lamps operated nine in series.

Special attention has been given to street lighting about the terminal. The architects designed special posts or standards, those on the Madison Street front of the building being especially large and ornamental, while those for the sidewalk lighting on Canal Street, Clinton Street and Milwaukee Avenue are more simple in design, but quite artistic. The four large standards in front of the main entrance on Madison Street each support seven globes containing thirteen lamps. Three 150-watt lamps are placed in the 30-in. globe at the top. There are also four smaller globes near the top, each containing a 100-watt lamp, and lower down on the standard two globes each containing three 60-watt lamps, making a total of 1210 watts for each standard. The other street posts are equipped with three 60-watt lamps in a 20-in. globe at the top, while from each of three brackets depends a 12-in. globe containing a 60-watt lamp, making a total of 360 watts for each post. In all there are fifty-three lamp-posts in addition to the four large standards in front.

Considering the whole terminal, there are perhaps 5000 tungsten lamps connected, mostly of large size. In addition, about 350 tungsten lamps are used for the street lighting, while provision is also made for lighting the terminal yards and approaches north of the train sheds, where tungsten clusters on poles or brackets will be used.

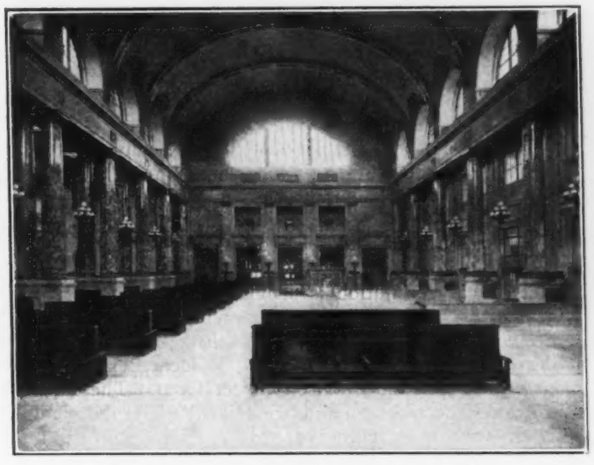


Fig. 5—Main Waiting-Room, Looking West.

Fig. 7—Day View in Dining-Room.

LIGHTING OF STANDING TRAINS.

Carefully designed equipment has been provided for the lighting of trains standing in the train shed. At the end of each track there are one or more train reels suspended overhead and containing a length of insulated cable connected to the 110-volt train-lighting circuits from the power house at one end and at the other provided with a suitable plug to be inserted in a receptacle to make connection with the car wiring. By the insertion of this plug connection is made so that the lamps and electric fans of the trains are operated while the train is at rest in the station.

Inasmuch as the train lighting is carried out on the 110-220-volt three-wire system, an ingenious application has been made to detect any unbalancing. Ammeter stands are provided with small Weston instruments connected in such a way as to show by the deflection of the pointer whether any particular train being supplied with energy causes an unbalance of the system. If this is so, the connections may be changed quickly so that the train-lighting load may be practically balanced. The capacity of the

Fig. 6—View in Women's Tearoom.

Fig. 8—View of Train Concourse.

train-lighting system is for the simultaneous supply of electrical energy to six trains, each taking 25 kw.

With 2400 amp supplied to the main building for lamps and motors, the lighting load is so well balanced that the maximum unbalance amounts only to about 60 amp. However, two duplicate balancing sets are placed in the switch-

Fig. 9—Newel-Post Lighting Fixture.

board room in the basement of the main building, as shown in Fig. 11. These balancers also take care of the balancing of the train-lighting load, to which reference has just been made.

SEARCHLIGHT AND CLOCK DIAL ILLUMINATION.

Above the train shed over the east entrance to the Washington Street subway there has been installed one of the most unusual features of the building in the shape of a permanent searchlight with a perpendicular beam intended to advertise the location of the Northwestern Station all over the downtown section of the city. A General Electric 24-in. searchlantern is placed in the clock machinery room at this point. It is set so that the beam of light is projected horizontally. A mirror is provided so that the light is deflected upward in a vertical position.

Each of the towers of the main building contains a clock dial 10 ft. in diameter. There are also other clocks of the same size on the train-shed walls. Each of these clock dials is electrically illuminated by twenty-four carbon-filament lamps of 16 cp each. These lamps are placed behind the dials and arranged on a ring support in such a manner that any one of them can be reached for renewal by moving the supporting ring which turns on rollers placed about its outside rim. It may be added that the hands of these large clocks are driven by small electric motors.

HEATING AND VENTILATION.

The entire heating system throughout the terminal is a vacuum system, this permitting of utilizing all of the exhaust steam from the engines and other steam-driven machinery. The surplus is used in the exhaust-steam turbine in the power house, as noted in the preceding article. Two 14-in. pipes are installed for transmitting exhaust steam from the power house to the main building. These pipes, together with a 5-in. high-pressure steam pipe for the elevator pumps, are carried in a runway above the train shed on the Clinton Street side of the terminal. The terminal property being divided by the intersecting streets into practically four sections, it was necessary to treat each section as a separate building so far as the return end of the heating system was concerned. Each block, therefore, has its own duplicate set of vacuum pumps, although these deliver into a common return running back to the power house, except that an independent return is run from the main building.

The exhaust from engines and other steam-driven machinery in the power house is utilized for heating purposes and is supplemented at the main building by exhausts from the elevator pumping machinery and the pumps used in connection with the heating system. During the summer months the exhaust from the elevator pumps is utilized for the heating of water for the kitchen and toilet-rooms, etc., thus allowing the service mains from the power house to be cut out. In operation it has been found that it is possible to utilize the excess supply of exhaust from the elevator pumping machinery during the summer time by opening the valves in one of the 14-in. mains connecting with the power house, the steam passing back through this and being used in the exhaust steam turbine, this pipe acting as a regenerator.

Mechanical ventilation is provided in very complete detail, electrically operated fans supplying outside air which is heated, if necessary, and also washed. The main ventilating plant for the main building is located in the basement underneath the Madison Street front. The fans are all of the Sirocco design and are driven by Sprague motors. The air-washing machines are of special design and the success of the ventilating plant was well attested during the extremely warm weather of the early summer of this year. At that time the temperature of the main waiting-room and the public space on the track-level floor was from 10 deg. to 15 deg. lower than the temperature of the outside air.

The air is exhausted from all ventilated portions of the building by fans located on the fourth story, there being three installations similar to the delivery fans in the basement. Fig. 12 shows an installation of exhaust fans, also, on the left, electric motors operating dumb-waiters. All of these fans are motor-driven and are operated by remote-control from panelboards at each individual fan installation in the basement. A small Weston ammeter connected with each exhaust fan motor on the fourth floor indicates that that fan is operating. The motors are of the variable-speed type, and it is expected that they will be operated at their normal speed during the winter months and at a

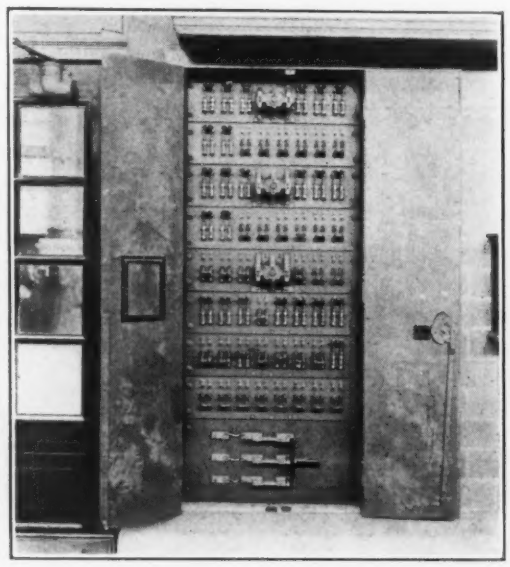


Fig. 10—Cutout Cabinet in Train Concourse.

higher speed during the summer, the latter being accomplished by field weakening. The same method of control is applied to the motor-driven centrifugal pumps circulating the water for washing the air. All register faces for heating and ventilating openings in public spaces are of solid bronze.

MOTOR APPLICATIONS.

Electric motors with a total rating of 932½ hp are installed in the terminal. They range in size from 1½ hp to 75 hp and are used for driving pumps, fans, hoists, elevators and various other mechanisms. The elevators in the main station building are hydraulic, but there are ten electric elevators in the under-track portion of the terminal. These are located north of Randolph Street, and eight of them are for outgoing baggage and express and two for mail matter. The lift is about 19 ft. and the elevator mechanism, which is of the Otis drum type, is equipped with a 25-hp motor.

Four mail conveyors are placed between tracks in the train shed and so arranged as to permit of readily unloading mail from the cars, dropping it into these conveyors at any point where the car to be unloaded may stand. The mail sacks are delivered to the post-office substation, coming down onto distributing tables. This post office is located on the street level between Washington Street and the suburban concourse.

VACUUM CLEANING.

Two complete installations for vacuum cleaning have been made, each of eight-sweeper capacity under continuous service. One system is installed in the machinery room of the main-building basement to care for that building, while the other is installed in the machinery room in the under-track portion of the terminal, just south of Randolph Street. This latter plant cares for all the under-track space between Randolph and Washington Streets, with separate connections leading to the post office. The apparatus in these plants was furnished and installed by the Vacuum Engineering Company.

REFRIGERATION.

Each serving-room—that is, the one for the lunch counter on the ground floor, the one for the dining-room on the track level floor and the one for the women's tearoom on the third floor of the main building—is equipped with a refrigerator box which is cooled by brine circulation from a refrigerating plant located in the sub-basement of the main building.

The refrigerating apparatus was installed by the Carbondale Machine Company and is a 50-ton absorption plant. It also cools drinking water for the entire terminal, including the power house, the system of piping being divided,

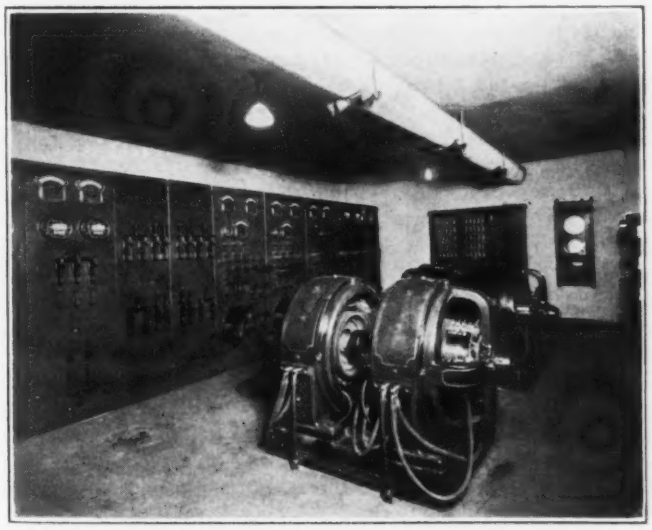


Fig. 11—Switchboard-Room in Basement of Main Building, Showing Balancers.

one pump caring for the main building and the other for the under-track portion of the terminal, including the power house. City water is used for drinking purposes, but it is thoroughly filtered. A plan formerly worked out by the consulting engineers for the terminal station has been used here for the cooling of milk. Refrigerated water is circulated between the outer and inner shell of the milk coolers, rendering the use of ice unnecessary and making it very much more convenient than to keep the milk in refrigerator boxes.

As the refrigerating system uses ammonia, the room in which the apparatus is installed is designed with the idea

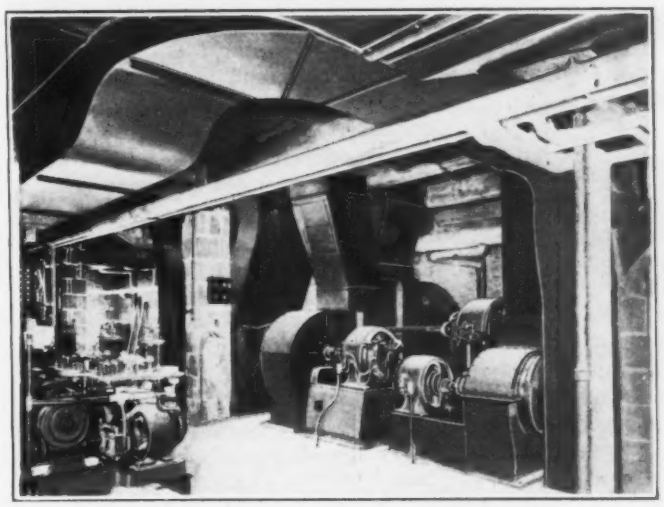


Fig. 12—Motor-Driven Exhaust Fans and (at the Left) Electric Mechanism for Dumb-Waiters.

of being entirely closed off, and a separate ventilating plant, electrically driven, has been installed, which will entirely clear the room every three minutes. Doors have been arranged at opposite corners of the room so as to afford ready egress to anyone working in the plant should a breakdown occur. All precautions have been taken for the protection of the men operating this system, although no accidents with a plant of this kind have ever occurred within the experience of the engineers who designed the plant.

The drinking fountains in those portions of the terminal open to the public are equipped with double faucets, one of the usual type and the other of the sanitary bubbling design. The latter type is used exclusively in the post office and in the emigrants' quarters, as well as in the power house.

COMMUNICATION AND ALARM SYSTEMS.

An intercommunicating telephone system has been installed throughout the terminal. It was supplied by the Couch & Seeley Company, and connects all of the operating departments of the terminal from the main building through to the power house.

A complete McFell fire-alarm and watchman's clock system has been provided with fire-alarm boxes located at convenient stations. Storage batteries for the operation of this system are installed in the basement of the main building. In connection with this local fire-alarm system a city fire-alarm box has been installed adjacent to the switchboard of the local system, and thus an alarm may be turned in to the city after it is registered in the switchboard-room of the local system, thus linking the city fire-alarm system and the local protection.

Telautograph stations are placed in various localities around the terminal and orders written at any station are reproduced at other stations in writing. The telautograph system is used in connection with the issuing of train orders and is operated in connection with the telephone system. The dining-room in the main building has been equipped with a telautograph service of its own, so arranged that orders written in the dining-room are reproduced in the kitchen.

DUMB-WAITERS.

As the kitchen is located in the basement of the main building, where is also the serving-room for the lunch

counter of the ground floor, it was necessary to devise some quick means of transportation between the kitchen and the serving-room for the dining-room on the track-level floor and the serving-room for the women's tearoom on the third floor. For this purpose three electrically controlled dumb-waiters have been installed, and in addition to the customary control-button system a buzzer system has been added, which greatly facilitates the operation of these small hoisting conveniences. The motors operating these dumb-waiters are placed on the fourth floor and are shown to the left in Fig. 12.

PNEUMATIC TUBES.

All incoming baggage is delivered on the ground-floor level in the baggage-room under the main concourse of the main building, while the outgoing baggage is delivered to the baggage-room in the under-track portion of the terminal between Randolph and Lake Streets. It was necessary to establish some quick means of communication between the two baggage-rooms. This was accomplished by installing a pneumatic-tube system with terminals in the two baggage-rooms mentioned. Special carriages are used in these tubes, being elliptical in cross-section. The blowers are installed in duplicate and are driven by Sprague motors, the power plant for this system being placed in the basement of the main building. The pneumatic-tube system was installed by the Lamson Consolidated Store Service Company.

CONDUCTORS' AND TOWERMEN'S GATE SIGNALS.

A carefully worked-out electric-lamp signal system has been devised for the exchange of signals between the towermen, the conductors of outgoing trains and the gatemen. The lamp signals are contained in neat cases placed at convenient points in the train shed. About five minutes before the starting of a train the towerman signals by the lighting of a lamp that the track is clear. This signal is given to the conductor who is standing beside his train and near the signal station. One minute before the time for the train to leave the conductor signals the gateman to that effect by pressing a button, which lights a lamp at the gate permitting the ingress of passengers. The gateman then closes the gate, and when he has done so signals the conductor in the same manner, but in this case the signal is also produced in the signaling tower, so that both the towerman and the conductor know the instant the gate is closed.

Fifteen wires are needed for each track for this signaling system, which is interlocked or relayed in such a manner that one signal cannot be given the towerman or conductor until preceded by the one that should properly come before it.

IMPROVED TELEPHONE-BOOTH DOOR SWITCHES.

Ordinarily telephone booths are provided with doors which are normally open, and when the customer goes in and closes the door after him a lamp is lighted by that act. The telephone-booth doors at the Northwestern Terminal Station, however, are arranged on a different principle. It was desired to have the booth doors normally closed, and the automatic switches installed, which are made by Edwards & Company, are so designed that opening the door lights the lamp. Shutting the door after entry, however, does not extinguish the lamp, which still burns, but opening the door the second time by the person inside passing out extinguishes the light.

ELECTRIC-CLOCK SYSTEM.

All wall clocks in the terminal—there are about forty of them—are electrically regulated from a master clock in the office of Mr. A. J. Farrelly, electrical engineer of the Chicago & Northwestern Railway Company, who has his quarters on the fourth floor of the main building. Mr. Farrelly's office is in direct connection with the United States Observatory at Washington, and thus the master clock is in close telegraphic connection with the nation's source of correct time.

MISCELLANEOUS.

Compressed air is used for many purposes around the terminal, including the cleaning of cars and the blowing out of electrical and other machinery. The air is piped also up to the ledges containing the concealed lamps for lighting the ceiling of the main waiting-room, and the shades of these upwardly pointing 250-watt lamps are blown out by compressed air. Compressed air is also supplied to the barber shop for use in tonsorial operations.

The hose pumps of the main building are electrically driven and there are two small motor-driven circulating pumps in the undertrack hot-water system in blocks 2 and 3—that is, the portion of the terminal between Washington and Lake Streets. A garbage crematory also forms a portion of the remarkably complete mechanical equipment of this terminal station. Another feature is the provision of steam-heating pipes for melting the snow in the yards in winter so that the tracks can be cleaned with dispatch during any heavy snowfall.

Train signaling for the operation of the terminal is all-electric and interlocking. There is a tower at Lake Street and Milwaukee Avenue, near the power house, from which it obtains its electrical energy. In this tower there are sixty-seven levers for signals, twenty-nine for switches, forty-six for double-slip switch ends, twenty-three for movable-point frogs and six to govern traffic, making a total of 171 working levers.

Pierce, Richardson & Neiler, Chicago, were the mechanical and electrical engineers for the remarkably well-equipped Northwestern passenger terminal.

THE ELECTRIC VS. THE GASOLINE VEHICLE.

By Hayden Eames.

CONTRARY to popular opinion, the cost of maintenance of an electric vehicle is, in general, less than that of a gasoline vehicle of the same load capacity, and furthermore, and equally contrary to popular opinion, the disparity between the load efficiencies of the two types is very trifling, with the advantage at present in favor of the electric, but possibly ultimately in favor of the gasoline truck.

It does not follow from this, however, that installations of electric vehicles under all circumstances are cheaper to operate than installations of gasoline vehicles for the same purposes. If the service of the gasoline vehicle is not restricted by external conditions, it can do more work in a given time—that is, transport the same number of tons more miles than the corresponding electric vehicle. As a rule, however, in the majority of large cities the number of stops required, the congestion of traffic and the conditions governing the daily routine deprive the gasoline vehicle of this advantage, and in consequence under the circumstances named, and within the radius of its safe application, the electric vehicle has the full advantage of its superiority in the matter of maintenance.

On the other hand, it also not infrequently happens—in fact, is happening now in a number of cases in the city of Cleveland, for instance—that the driver of a power wagon in the service of a small merchant not only takes mechanical care and makes minor repairs upon the vehicle which he drives, but incidentally has the delivery periods so regulated that he has numerous other duties in and about the store. At the present state of electric-wagon education it would be hardly possible to employ for this purpose a man who had had the training necessary to qualify him to care for an electric vehicle, so that, with rare exceptions, the gasoline vehicle may be expected to show up to the better advantage in this service, and, in fact, actually does so.

The confusion that has existed in the people's minds on the subject of the load efficiency of electric trucks has been

partly due to the subconscious error that "a pound of lead is heavier than a pound of feathers," and partly to differences of rating, and, more especially on the part of engineers, however, to a failure to recognize that a gasoline automobile for a given weight, duly filled with gasoline, is the embodiment of more ton-miles than the electric automobile with the same capacity with its necessarily limited but entirely adequate radius of action.

I have before me some authentic load efficiencies collected in this country and in France in 1905 in which the ratings of the various vehicles considered have been reduced to a common standard. Three French gasoline trucks of 2½ tons, 3 tons and 4 tons respectively had load efficiencies of 39 per cent, 31 per cent and 44 per cent, as compared with 57 per cent, 45 per cent and 42 per cent on the part of electric vehicles of 5-ton, 3-ton and 2500-lb. capacity respectively.

Academically, in spite of the great difference in the radius of action, the gasoline truck can undoubtedly be designed with a higher load efficiency than an electric truck of the same capacity, but the disparity will be small at best, and in proportion as that disparity is increased in favor of the gasoline truck, its cost of maintenance will also increase. Consequently in practice it may be assumed that, except in the very lightest ratings, the attempt to increase the load efficiency of a gasoline truck over that of the corresponding electric truck would be economically inexpedient.

In comparing various trucks, not only of different motive powers, but also of the same motive powers, one of the greatest difficulties is the reduction of the arbitrary ratings to a common standard. No one element of dimension is sufficient for the purpose. In the almost wholly empirical design and production of draft-animal vehicles the factors of safety are simply enormous except in the heaviest units. This is, of course, the result of fierce and protracted competition and habitual misuse and abuse of the vehicles. Under normal circumstances the possibility of misuse and abuse diminishes as the capacity of the vehicle increases. The early power wagons, and the great majority of all electric power wagons, inherited their structural designs and ratings from draft-animal-wagon practice. This seems to be always true with electric vehicles with the exception of one single make. The practice is a wise one. The customers to whom the vehicles are sold cannot shed their draft-animal standards immediately, and to some extent indefinitely and perhaps perpetually the power wagon is going to be subject to very much the same misuse, if not abuse, as that suffered by the draft-animal wagon heretofore. The designer and manufacturer of the electric truck and wagon, with the possible exception noted, have therefore been wise in taking advantage of past experience in street traffic and wagon use to discount this possibility, which is a very real one and which would otherwise have reacted upon them sooner or later. To the fact that most designers of electric power wagons have taken the fullest advantage of the purely empirical lessons to be learned from draft-animal-wagon experience the electric truck owes most of its extremely long life and slow depreciation.

Some wise gasoline-wagon manufacturers approximate the same practice. The majority of designers of gasoline vehicles, however, have learned from their superior education to view with contempt the empirical development of the draft-animal wagon, entirely overlooking the fact that instead of the definite requirements of railway practice there have been the most highly indefinite conditions of road service, human errors of administration and load requirements upon which to base computations. They overlook the fact that the result of empirical development of the draft-animal wagon must more or less accurately represent the aggregate compromises of design which years of experience have shown to meet best the uncomputable and indefinite requirements of the service. In consequence of this the great majority of gasoline vehicles are designed in accordance with railway practice on the basis of a factor of safety figured on rated load. As a result the published ratings of the majority of gasoline vehicles are higher in proportion to actual capacity than those of any make of electric vehicles but one, and, in consequence, their actual factors of safety on rated load are lower and their depreciation and repairs necessarily correspondingly greater. A purchaser of any power wagon whatever, therefore, should disregard the published ratings and try to make his comparisons of trucks of various makes and motive powers as nearly absolute as possible.

Perhaps the best basis of comparison for a hasty judgment is the size of the axle spindle—that is to say, its diameter at the shoulder. This is by no means absolute, not only because of minor differences of design in the spindle and axle, but because of a few cases in which the designer takes the fullest advantage of stronger than ordinary axle material. The resulting differences, however, are not great and after a little practice the observer can arrive at a very fair comparison by a consideration of the axle size in combination with the general dimensions, the springs and other parts of the structure, and of the structure as a whole. In the greater part of the structure difference in the quality of the material has heretofore made very little difference in the dimensions and weight of the parts for a given actual use. So much for an analysis of the facts.

The difficulty of obtaining a competent battery overseer or caretaker at any wage justified for the care and operation of a single light vehicle necessarily opens a very large use for the gasoline vehicle even in a field which would otherwise be legitimately of proper application for the electric. This objection should not apply in the case of central stations. If any central station in any important town has not already some one on its staff manually familiar with the care and operation of electric vehicles, it ought to have, and it ought not to employ such a man without inquiry of some thoroughly well-established storage-battery company or other organization that has been obliged to keep track of this kind of "talent." The storage-battery vehicle has suffered about enough from the ministrations of recent graduates of high schools and of academic electricians. Even the thoroughly well-grounded and able central-station electrician, thoroughly familiar and expert in the oversight of stationary storage batteries, is not infrequently almost as bad for the storage-battery vehicle as "my nephew who has just left college and knows all about electricity." The care of an electric storage-battery vehicle or a station full of them is a "trade," not a science, and a man may know ever so much about how to do it and still not do it right. It has been our experience that in the early days of the storage-battery vehicle it suffered quite as much from excess care and unnecessary "treatment" as it did from neglect. The best possible injunction is the frequent one of those who know, namely, "intelligently leave it alone," and this is quite a trade in itself.

The same reason, therefore, that makes the operation of a single electric-power wagon on a small scale possibly costly can be made to operate very strongly in favor of the use of such a wagon on the part of the central stations, and, in view of the fact that the central station's principal interest in the matter is the sale of electric energy under favorable circumstances, it would certainly be a serious example of penny wisdom for a central station in any large-sized city to buy a gasoline-power wagon for its own use within the legitimate radius of action of an electric vehicle, even though its rating indicated the gasoline vehicle to have the advantage as to initial cost. On the other hand, every central station in a large city has some service which at some time in the year, and in many cases throughout the year, can be more effectively performed by a gasoline-power wagon than by any other method, and to fail to take advantage of the gasoline vehicle for this purpose and de-

cline to operate any power wagons except electrics is not only on the face of it an extremely narrow and, of course, uneconomical position to take, but one that will inevitably tend to retard the introduction of the power wagon generally and, therefore, the electric vehicle. The very superiority of the electric vehicle in its own field is a guarantee that the general introduction of the power wagon will necessarily lead to the establishment of the electric vehicle where it can do the best work.

To those of us who have been interested in, actively connected with and continually investigating the power wagon and power-wagon applications and economies for a matter of fifteen years the draft animal in city service is a joke. Our standards have changed. We no longer take it as a matter of course when a horse falls down in crowded traffic without apparent cause; when upon being overtaken (as he usually is) he speeds up and thereby momentarily increases the traffic congestion in the street; when he shies at the imminent risk of street accident; when he stops and starts, generally at inopportune moments; when he gives out at the critical moment when he is perhaps most needed, as he very frequently does; when he runs away and smashes up people and things, including himself; when he meanders down the crowded street in a sinusoid, or when he pushes his head point blank into a street car and shoves the pole through the windows, with the driver strenuously trying to restrain him, as he is just doing now as I look out the window. A few moments ago this highly archaic form of motor sat down on the street-car track in the public square, and while a power wagon could possibly have been pushed off the track by hand, nothing short of a derrick would have done the trick in this case, and the blockaded street cars of a crowded city stretched down the track as far as the eye could reach.

But hundreds of thousands of years of use of this perfectly miserable form of unreliable automatic motor have so accustomed the public to its tremendous shortcomings that until very recently they were almost prepared to reject any motor which did not suffer from the same troubles. For ten years past the horse has been the most uneconomical known means of merchandise transportation in cities. That the public should recognize this and act on it is the first step toward what the central stations wish to attain. Part of the work can be most economically done with electric automobiles and a part of the work most economically done by gasoline automobiles.

The principal difficulty to-day is to wean the public from its horse traditions. If it is going to take two or three years for the public to recognize the superior economy of the electric wagon, and the public is all ready to accept the gasoline wagon, the latter is the more effective means for doing this weaning, and, in fact, will ultimately form a stepping stone to the use of the electric vehicle in the fields in which the latter happens to be of superior economy. If the influence of the central station can be exerted to anticipate materially "equilibrium" in this choice, so much the better. Every time an electric central-station management procures the use of a gasoline-power wagon in its proper field it is hastening the day when the use of electric wagons in their proper field will bring to that central station the already well-recognized profits at the very period of the day that is most convenient to it. The central-station management can make no greater mistake than to try to keep gasoline vehicles out of its territory or in any way to retard their introduction.

Even if a gasoline truck is about to be purchased for a field which can be more advantageously occupied by the electric one, or in the doubtful field of the two spheres, it is better to help the sale through than to permit continued dependence on the horse. The essence of the whole proposition is so to educate the public as to make it as disgusted with and contemptuous of draft-animal transportation as are those who are really familiar with the comparative economies of the various methods. There is no better way to do this than to help it succeed with whatever initial substitute for the horse it can be most quickly brought to adopt. If it is an electric vehicle in an electric field, then so much the better, both for "equilibrium" and for the central station, and if not, then a gasoline truck and, wherever possible, each in its own field.

Anything but the heavy-footed, hopeless, meandering, uneconomic, uncertain draft animal. The horse for pleasure perhaps, but not for business.

REGENERATIVE CONTROL FROM A COMMERCIAL VIEWPOINT.

By J. Gustaf V. Lang.

As mentioned in the previous article, the ideas incorporated in the equipment tested in the last Newcastle test were later worked up into more practical shape and a number of equipments built. Several of these were installed at Norwich, England, where they were run in regular service and a series of tests was carried out.

First preliminary tests were made with watt-hour meters which were prevented by small ratchets from operating in other than one direction. One of these instruments was connected so as to register the input, the other the output. Both the standard equipment and the regenerative equipment used for the tests were mounted on similar single trucks. The car with the standard equipment weighed, complete, 18,102 lb., and the car with the regenerative equipment 19,817 lb. Part of this difference in weight was due to a special brake equipment which was designed to bring the mechanical brakes into play when the controllers

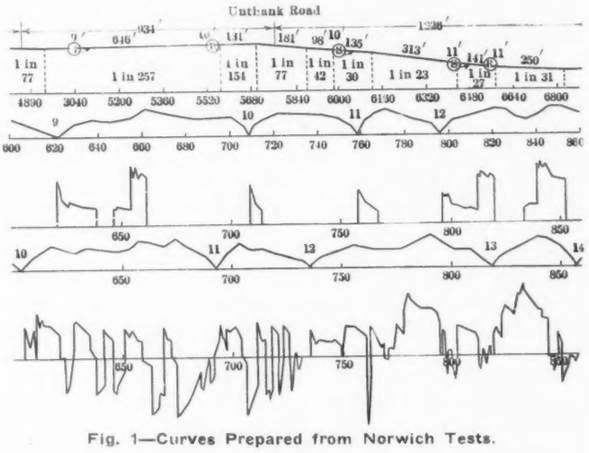


Fig. 1—Curves Prepared from Norwich Tests.

were brought to their off position or in cases of emergency.

Mr. A. Beazley carried out the final test, for which he used the most modern forms of recording voltmeter and ammeter, particularly constructed for tests on traction equipments. The following is a somewhat condensed abstract from Mr. Beazley's report:

Both instruments were fitted with chronograph markers operated electromagnetically from a clockwork. On one of the papers a record of each revolution of the car wheel was made by a distance marker, a contact maker placed on the hub of the wheel operating the marker electromagnetically. The circumference of the wheel having been measured, the distance could be calculated very closely.

The ammeter was set with its zero in the middle of the paper so that both input and output might be recorded. The cars were taken over nearly all the routes in the city and were operated under service conditions so that any faults likely to develop out of exigencies of ordinary service might be located. The particular route the record

of which was selected to be worked out in detail was that from the Royal Hotel to Unthank Road and back, which may be considered a fair average of the city routes as regards grades, curves, etc. A section of the records as worked out from the data obtained from these runs will be found plotted in the accompanying diagram, Fig. 1. It is to be observed that the wattage and speed curves are plotted on time, and thus to locate the corresponding part of the road in the profile it is necessary to refer to the exactly the average of the three figures given in the table. The figures for the regenerative equipment are taken from that part of the route (Haymarket to Unthank Road terminus) to which the chosen figures of the standard equipment apply. The results then appear to show an energy saving in favor of the regenerative equipment of about 25 per cent, as given in Table II.

The regenerative equipment during the test maintained an average speed of 7.05 miles per hour with 8.5 stops per

TABLE I.—RESULTS OF RUNS FROM ROYAL HOTEL TO UNTHANK ROAD.

Number of Run.	Type of Car.	Direction of Run.	Stops per Mile.	Running Time Seconds.	Average Speed, Miles per Hour.	Input, Kw-hours.	Output, Kw-hours.	Net Input, Kw-hours.	Net Input, Kw-hours per Car-Mile.	Average Speed, Miles per Hour.
*1	Standard....	Out	8.69	1053	6.3	2.395	....	2.395	1.04	6.18
		Back	10.00	1069	6.06	1.41	....	1.41		
*2	Regen.....	Out	8.69	957	6.93	2.44	0.287	2.153	.91	6.72
		Back	10.00	996	6.52	1.71	0.594	1.116		
**3	Standard....	Out	7.2	989	6.59	2.60	....	2.60	1.28	6.52
		Back	6.09	1071	6.06	2.015	....	2.015		
**4	Regen.....	Out	7.2	976	6.66	2.50	0.30	2.20	.923	6.52
		Back	6.09	1016	6.40	1.73	0.60	1.13		

*Tests with graphic recording meters. **Tests with watt-hour meters.

stops. Those of the standard car are marked *S* and those of the regenerative car *R* on the profile, Fig. 1.

The figures obtained by integration of these curves in their complete form are entered as runs 1 and 2 in Table I.

Runs 3 and 4 are preliminary watt-hour meter tests. It will be noticed that while runs 2 and 4 with the regenerative equipment check very closely, and run 1 "out" checks fairly well with run 3 "out," there is a very considerable discrepancy between run 1 "back" and run 3 "back." Furthermore, another preliminary test with a standard car over this route showed a total input for the round trip of 4.18 kw-hours, or 1.16 kw-hours per car-mile. This is a mean between the other figures, 1.04 and 1.28. It is reasonable to suppose, and this opinion is verified from several other tests elsewhere, that this discrepancy is caused by the great difference in the handling of a car on a down grade by different drivers.

In view of the above divergence of results it becomes necessary to decide on some reasonable basis which would be fair to both equipments. Mr. Banister, engineer and manager of the Norwich Tramways, had made a series of measurements of the energy consumption for one week of all the standard cars running on various routes by mounting watt-hour meters on the feeder poles.

Among the routes so measured was the greater part of the one under consideration, that from Haymarket to Unthank Road terminus and back. It has therefore been accepted as a fair basis to adopt the average input per car-mile thus obtained as the correct figure for the standard equipment, this decision being supported by the fact that the input, 1.15 kw-hours per car-mile, so found is almost

mile. The average speed of the cars on which Mr. Banister's observations were made was not noted, but during the test recorded by graphic instruments the standard car made an average speed of 6.28 miles per hour with 8.5 stops per mile. While it is evident that the regenerative equipment is able to operate a schedule at least 10 per cent faster than the standard equipment, it is hardly possible to make any allowance for this in the energy consumption. But the preceding fact should be noted and may be considered as a margin indicating that the regenerative equipment can develop an average saving of 25 per cent in energy consumption over the standard equipment under the conditions existing at Norwich, which conditions, however, can scarcely be looked upon as favorable to regeneration.

For the sake of completeness it may be appropriate to mention that, though Mr. Banister's measurements were taken on cars in traffic whose average load was calculated to be eight passengers, the comparison with the regenerative equipment is quite fair since the extra weight of eight passengers was offset in the case of the regenerative car

TABLE II.—RESULTS OF RUNS FROM HAYMARKET TO UNTHANK ROAD.

Number of Run.	Type of Car.	Direction of Run.	Running Time, Seconds.	Average Speed, Miles per Hour.	Input, Kw-hours.	Output, Kw-hours.	Net Input, Kw-hours.	Round Trip.	
								Kw-hours per Car-Mile.	Average Speed.
1	Standard.....	Out	855	6.4	1.77	....	1.77	.945	6.28
		Back	868	6.15	1.053	....	1.053		
2	Regenerative.....	Out	748	7.24	1.868	.232	1.636	.865	7.05
		Back	777	6.87	1.415	.468	.947		
Standard average of all cars for one week.....								1.15	

by the weight of the testing apparatus and the members of the testing corps.

The higher accelerating efficiency of the double series-parallel system with field control is apparent from the fact that the gross input to the regenerative equipment was 1.099 kw-hours per car-mile, as against 1.15 kw-hours for the standard, which indicates a saving of 5 per cent. In reality this saving is larger because the weight of the regenerative car was 9½ per cent greater than that of the standard car as already mentioned, consequently the input is proportionately larger. At the same time the regenera-

tion is greater in the same proportion. Taking the average figure from the tests given in the first table, the gross input to the regenerative equipment is just the same as that to the standard. Reduced to the same weight, however, this indicates a higher propelling efficiency, mainly due to higher accelerating efficiency, and corresponding to a saving in input of 9.5 per cent.

If the total saving is reduced to equal weight of cars, and the average values of the first table are used as a basis, then 0.916 kw-hour for the regenerative equipment would compare with 1.16 x 1.095 kw-hours for the standard equipment, indicating the total saving to be 28 per cent.

TEST AT SOLINGEN, GERMANY.

A duplicate of the equipments used at Norwich was tested in Germany at Solingen, well known as the home of the German cutlery factories. Both the regenerative and standard equipments were mounted on similar single-truck cars. The route over which the test runs were made covered a distance of 1.2 miles, rising during almost the whole distance until a final elevation of 160 ft. above the starting point was reached, after which there was a fall of 12 ft. in the last tenth of a mile. The profile of the road is given in Fig. 2.

The first test runs were of a preliminary character and the elaboration of the final test of timing each run between stops was not bestowed on them. The results from the preliminary tests, however, are of much value for comparison.

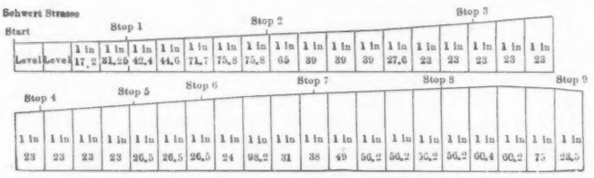


Fig. 2—Profile of Tramway Route, Schwert Strasse, Krahnhohe, Solingen, Germany.

All the tests were carried out with watt-hour meters which were free to rotate in either direction. The energy returned to the line was consequently subtracted directly by the meters.

The regenerative car was driven by the chief inspector, who had no previous practice in handling this kind of an equipment. The preliminary tests consisted of four return trips and the total time of each trip, including stops, was noted. As the line was single-tracked, the variation in time is mostly due to delay at the turnouts. The following day a similar test was carried out with a standard equipment, the car being driven by an ordinary motorman. After the first run the driver was instructed to drive as economically as he could. It is to be regretted that the actual running time was not noted because it would have been of interest to determine how much this endeavor at economy on the part of the driver impaired the running speed.

The consumptions registered during the preliminary test were as follows:

REGENERATIVE EQUIPMENT.			STANDARD EQUIPMENT.		
Trip.	Kw-hours.	Time (Seconds) Excluding Stops.	Trip.	Kw. hours.	Time (Seconds) Excluding Stops
1	2.21	1001	1	3.33	1015
2	2.22	985	2	3.36	971
3	2.20	997	3	3.41	971

During the final test, which was carried out over the same route, the actual running time between each stop was observed and the watt-hour meter readings at the beginning and end of each such period were noted.

The chief inspector also handled the regenerative equipment during the final test. The standard equipment was similar to but not the same as that used in the preliminary test and it was driven by a different motorman. In the final test all the runs with both equipments were made the same day. The results were as follows:

REGENERATIVE EQUIPMENT.			STANDARD EQUIPMENT.		
Trip.	Kw-hours	Minutes.	Trip.	Kw-hours.	Minutes.
1	2.20	21	1	3.22	20
2	2.30	19	2	2.87	20
3	2.11	19	3	2.80	21
4	2.08	20	....	....	..

The figures of the three runs in each case correspond exceptionally well. The average net input was 2.21 kw-hours for the regenerative equipment against 3.37 kw-hours for the standard, the respective running times being 994 and 986 seconds.

This indicates an average saving of 34.4 per cent in the final test. Taking the average of the preliminary and final tests in conjunction, the net energy consumption for the regenerative equipment is 2.19 kw-hours, against 3.17 kw-hours for the standard equipment. The saving is still 31 per cent in spite of the fact that two out of the six runs with the standard equipment were made with special attention to economy in energy consumption.

Comparing the six runs with the standard car the enormous variation in input is striking. It is evidently due to differences in the handling. This marked influence of the personal element of the driver on the energy consumption of a standard equipment has been noticed in all the different tests at Newcastle, Norwich and other places. On the other hand, the variations of the net input to the regenerative equipments are very insignificant, and it seems as if the results obtained are practically the same whether the regenerative equipment is handled by a man with considerable previous experience or by one to whom it is entirely new. This is a rather important argument in favor of regeneration, since all the special efforts, time and money now spent on instructing and inducing motormen to run the standard equipments economically can be dispensed with. This in itself means a considerable saving.

A very interesting test was carried out for the purpose of substantiating the claims to increased accelerating efficiency. On a level stretch of road ten runs were made with each equipment, during which the controller was moved to the top notch as uniformly as possible. Ten seconds after starting the current was broken and the distance covered from the starting point was noted. The average distance was found to be 148 ft. with a maximum variation of 3 ft. The input to the standard equipment had been 1 kw-hour and that to the regenerative equipment had been 0.79 kw-hour. A similar series of runs was made with the regenerative car, differing from the previous tests in that at the end of the ten seconds the kinetic energy was regenerated as far as possible. The net input was then found to be 0.55 kw-hour.

An analysis of these results shows that the accelerating efficiency of the regenerative equipment is higher than that of the standard and corresponds to a saving of 21 per cent. Since there was some difference in the weight of the two cars, the regenerative car being somewhat heavier and thus causing an increase in input to the regenerative equipment, the saving due to improved accelerating efficiency of this equipment, as compared with that of the standard, in reality agrees fairly well with the result theoretical deductions had led to be expected, as set forth in a previous article.

The car with the standard equipment weighed approximately six tons. As the 148 ft. were covered in ten sec-

onds, the maximum speed would have been 29.6 ft. per second had the acceleration been uniform. We know that this is not the case, and by comparison with the calculated acceleration curves published in the preceding article we can get some idea of the deviation. If a maximum speed of 27 ft. per second is assumed, the kinetic energy would be about 136,000 ft.-lb., which corresponds to 0.051 kw-hour, or 0.51 kw-hour for the ten runs. The track resistance, taken at 20 lb. per ton, would amount to 120 x 148 ft.-lb. per trip, or 178,000 ft.-lb. for ten trips. This equals about 0.07 kw-hour. The total useful work thus amounts to 0.58 kw-hour, and the standard equipment shows an efficiency during the accelerating period of 58 per cent, whereas the regenerative equipment, due to double series-paralleling and the practical elimination of main-circuit resistances, shows an efficiency of 73 per cent, which in reality is higher if corrected to equal weight of cars.

Unfortunately the distance covered during regeneration was not measured. On the assumption that this was about the same as that covered during acceleration there is 0.51 — 0.07, or 0.44, kw-hour of mechanical energy to be converted into electrical energy. The measurements seem to indicate that the conversion took place at an efficiency of about 55 per cent. In this connection it may be pertinent to question the reliability of measurements obtained in the test with regeneration, because of the decided momentum of the moving parts of the watt-hour meters at the time of the reversal of current.

Similar conditions no doubt existed to a greater or less degree during the other tests carried out at Solingen, as the same watt-hour meters were used in all of the tests, and after each stop on down grade the car was first accelerated by applying power before the regeneration was brought in. It is, of course, impossible to estimate to what extent sluggishness of the meters to respond to a reversal of the current would influence the results, but it is certain that it would tend to give regeneration less credit than it deserves.

It must be admitted that all the tests described support both each other and also the contention that a substantial saving in current can be effected. From the experience gained it would seem reasonably conservative to claim that on an average 25 per cent saving is feasible.

Since all these tests, however, were carried out with double-series-parallel equipments, the question arises to what extent this saving would be reduced if regenerative equipments with but single series paralleling were used.

The change from the first to the latter system would have an influence first on regeneration of kinetic energy and secondly on the accelerating efficiency.

Say for argument's sake that the maximum speed was 26 ft. per second and the speed variation by field control was

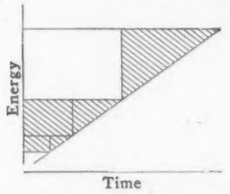


Fig. 3—Double-Series Parallel.

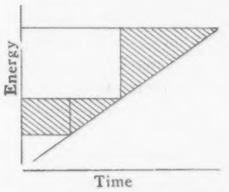


Fig. 4—Single-Series Parallel.

100 per cent, then the lowest speed with single control would be 6½ ft. per second, whereas with double control it would be 3¼ ft. per second. The total kinetic energy is proportional to the square of 26. The part capable of partial recovery by regeneration by means of a single-series-parallel equipment would be proportional to $26^2 - 6.5^2$, and that by means of a double-series-parallel equipment to $26^2 - 3.25^2$. Consequently the loss in kinetic-energy saving would be in the ratio of $6.5^2 - 3.25^2$ to $26^2 - 3.25^2$, or 4¾ per cent. Assuming that the regenerated energy is drawn half from kinetic energy and half from potential energy, the change from double to single series parallel would only reduce the regenerated energy to the extent of 2 per cent to 2½ per cent.

Looking, on the other hand, at the influence on the accelerating efficiency, the difference would come in mainly in the necessity of using a larger starting resistance. With the help of the diagram representation used by Mr. Hobart, referred to in a previous article and reproduced in Figs. 3 and 4, we can get some idea of the magnitude of the influence. The shaded area represents the saving in each case and measures for the double 31/96 of the total as against 28/96 for single series-parallel control. The latter is thus about 10 per cent smaller, which means that the saving with the latter system would be 10 per cent less than with the double as regards input during acceleration.

Applying these corrections to the results found by experiments with a double-series-parallel equipment showing a saving of say 30 per cent total, 6 per cent being due to increased accelerating efficiency and 24 per cent to regeneration (half of which is converted kinetic energy), a single equipment would be found to modify the figures as follows: Six per cent due to saving during acceleration would be cut down by 10 per cent, or be reduced to 5.4 per cent; and the 12 per cent due to regenerated kinetic energy would be reduced by 5 per cent, or cut down to 11.4 per cent. Thus the total would be changed from 30 per cent to 28.8 per cent, a reduction which is not worth mentioning. The only advantage of the double-series-parallel system is therefore the lower braking speed, which advantage is of little consequence as compared with the relative complications of the double-series-parallel equipment.

In the next article the additional cost of a double-series-parallel and single-series-parallel regenerative equipment over and above the cost of a standard equipment will be discussed and comparison will be made between the cost of maintenance of a standard equipment and regenerative equipments of double and single series-parallel types.

THE CALCULATION OF CAPACITY COEFFICIENTS FOR PARALLEL SUSPENDED WIRES—III.

By Frank F. Fowle.

In the previous article was given a treatment of problems relating to capacity coefficients involving metallic circuits. The treatment is continued in the present article and covers also mixed grounds and metallic circuits.

Six Wires, Three Circuits.—This case is an extension of the four-wire, two-circuit case, from two to three metallic circuits of two wires each, and can be solved with no difficulty by the general method for any number of metallic pairs. Without going through the deduction in detail, which has already been well illustrated by the case of three grounded wires, the results may be given at once and the reader may check the formulas if desired. The use of abbreviations is necessary on account of the length of the complete expressions. If

$$\left.\begin{aligned} a &= 2\log\frac{d^2_{12}}{r_1 r_2} \\ b &= 2\log\frac{d_{14}d_{23}}{d_{13}d_{24}} \\ c &= 2\log\frac{d_{16}d_{25}}{d_{15}d_{26}} \\ d &= 2\log\frac{d^2_{34}}{r_3 r_4} \\ e &= 2\log\frac{d_{36}d_{45}}{d_{35}d_{46}} \\ f &= 2\log\frac{d^2_{56}}{r_5 r_6} \end{aligned}\right\} \qquad (123)$$

The expressions of capacity are,

$$\left.\begin{aligned} C_{1212} &= \left(\frac{df - e^2}{D}\right) \\ C_{3434} &= \left(\frac{af - c^2}{D}\right) \\ C_{5656} &= \left(\frac{ad - b^2}{D}\right) \\ -C_{1234} &= \left(\frac{bf - ce}{D}\right) \\ -C_{3456} &= \left(\frac{ae - bc}{D}\right) \\ -C_{1256} &= \left(\frac{be - cd}{D}\right) \end{aligned}\right\} \qquad (124)$$

where

$$D = (adf + 2bce - c^2d - b^2f - ae^2) \qquad (125)$$

These formulas cover the general case of wires of any size and grouping, but neglect the effect of the images. In order to show the effect of three such circuits or pairs in

Fig. 14—Six Wires; Three Metallic Circuits.

one particular instance, the capacities will be calculated for the case shown in Fig. 14, where all conductors are No. 12 N. B. S. G. Such a case permits some simplification of the general formulas, but is too obvious to give in detail.

The calculated results appear in Table IV.

TABLE IV.—METALLIC CAPACITIES FOR FIG. 14.

Capacities.	Numerical Values.
C_{1212}	0.008224
C_{3434}	0.008229
C_{5656}	0.008224
$-C_{1234}$	0.0002188
$-C_{3456}$	0.0002188
$-C_{1256}$	0.00005456

By referring to the calculated capacities before given for two pairs of the same size and similar spacing it will be seen that the capacity of pairs *1-2* and *5-6* has been increased only one part in 8000 by the addition of the third circuit, while the capacity of *3-4* has been increased six parts in 8000, or about 0.07 per cent. The mutual capacity between pairs *1-2* and *3-4* or between *3-4* and *5-6* has been increased slightly by the addition of the third circuit; it would be decreased if the third circuit were reversed in position—that is, if the wires of the third pair were interchanged. The increase in the mutual capacity here amounts to only 0.64 per cent.

The capacity of pair *1-2* to pair *5-6* with pair *3-4* absent is $C_{1256} = 0.00004873$ microfarad per mile; the presence of pair *3-4* therefore increases the capacity about 12 per cent, but the reversal of pair *3-4* would diminish the capacity. These differences grow out of the assumption that conductors *1*, *3* and *5* are positively charged, while *2*, *4* and *6* are negatively charged.

Three Wires, Three Circuits.—This case has already been considered for grounded circuits, but three-wire circuits without a ground return or a grounded neutral point are very common. The fundamental equations are,

$$\left.\begin{aligned} V_1 &= u_{11}q_1 + u_{12}q_2 + u_{13}q_3 \\ V_2 &= u_{12}q_1 + u_{22}q_2 + u_{23}q_3 \\ V_3 &= u_{13}q_1 + u_{23}q_2 + u_{33}q_3 \end{aligned}\right\} \qquad (126)$$

which are subject to the condition,

$$q_1 + q_2 + q_3 = 0 \qquad (127)$$

If all the coefficients of the type u_{xx} were equal to each other and similarly all those of the type u_{xy} were equal to each other, it could be shown at once that

$$V_1 + V_2 + V_3 = 0 \qquad (128)$$

in consequence of (127). While these two conditions can be satisfied simultaneously in special cases, it is not true of the most general case. If the sum of the charges is zero, then the sum of the potentials is slightly different from zero, and vice versa. A system of transposition can be devised, however, to equalize these small differences and satisfy both (127) and (128) exactly.

In the case of grounded neutrals it is preferable, as a general rule, to follow the method used in the three-wire grounded circuit, but not always necessary. For example, consider the case shown in Fig. 15.

Assume that conductor *2* is the grounded neutral, and

$$\left.\begin{aligned} V_1 &= -V_3 \\ V_2 &= 0 \end{aligned}\right\} \qquad (129)$$

and also assume that

$$\left.\begin{aligned} r_1 = r_2 = r_3 &= r \\ d_{12} = d_{23} &= d_2 \\ d_{13} &= d \end{aligned}\right\} \qquad (130)$$

It follows at once from a consideration of (126) and the similar expressions for the charges that

$$\left.\begin{aligned} q_2 &= 0 \\ q_1 &= -q_3 \end{aligned}\right\} \qquad (131)$$

Whence,

$$\tfrac{1}{2}(q_1 - q_3) = \left(\frac{1}{4 \log \frac{d}{r}}\right) V_{13} \qquad (132)$$

Therefore, the neutral is without effect on the mutual capacity of the outside pair and is devoid of charge or potential. Such an arrangement of the conductors results in a balanced circuit electrostatically and a minimum charging current.

But there are many cases of three-wire circuits without grounds charged from insulated or so-called metallic sources; the sources may impress single-phase or polyphase emfs on the circuit. The fundamental equations are given by (126) and the fundamental limitation by (127). Hence it can be written at once that

$$\left.\begin{aligned} V_1 &= (u_{11} - u_{13})\, q_1 + (u_{12} - u_{13})\, q_2 \\ V_2 &= (u_{12} - u_{23})\, q_1 + (u_{22} - u_{23})\, q_2 \\ V_3 &= (u_{13} - u_{33})\, q_1 + (u_{23} - u_{33})\, q_2 \end{aligned}\right\} \qquad (133)$$

In this case the problem is with potential differences be-

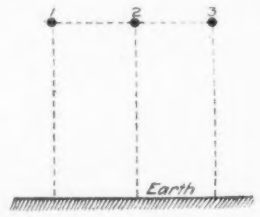


Fig. 15—Three-Wire Circuit with Grounded Neutral.

tween the conductors, and it should be observed that the sum of all the potential differences is zero, or

$$V_{12} + V_{23} + V_{31} = 0 \qquad (134)$$

Expressions (133) and (134) show that two independent equations may be obtained, as follows:

$$\left.\begin{aligned} V_{12} &= (u_{11} - u_{13} - u_{12} + u_{23})\, q_1 + (u_{12} - u_{13} - u_{22} + u_{23})\, q_2 \\ V_{23} &= (u_{13} - u_{23} - u_{13} + u_{33})\, q_1 + (u_{23} - 2\,u_{23} + u_{33})\, q_2 \end{aligned}\right\} \qquad (135)$$

or

$$\left.\begin{aligned} V_{13} &= \left(2 \log \frac{d_{12}d_{13}}{r_1 d_{23}}\right) q_1 + \left(2 \log \frac{r_2 d_{13}}{d_{12}d_{23}}\right) q_3 \\ V_{23} &= \left(2 \log \frac{d_{13}d_{23}}{r_3 d_{12}}\right) q_1 + \left(2 \log \frac{d^2_{23}}{r_2 r_3}\right) q_2 \end{aligned}\right\} \qquad (136)$$

And if (136) is abbreviated for convenience,

$$\left.\begin{aligned} V_{13} &= aq_1 + bq_2 \\ V_{23} &= cq_1 + dq_2 \end{aligned}\right\} \qquad (137)$$

it follows that

$$\left.\begin{aligned} q_1 &= \left(\frac{d}{ad-bc}\right)V_{12} - \left(\frac{b}{ad-bc}\right)V_{23} \\ q_3 &= -\left(\frac{c}{ad-bc}\right)V_{12} + \left(\frac{a}{ad-bc}\right)V_{23} \end{aligned}\right\} \quad (138)$$

where the coefficients of V_{12} and V_{23} are capacity coefficients. The solution is here complete if it is desired to have the charges per conductor. But in case the charge per pair or per phase, as in a delta system, is desired one more transformation is necessary.

$$\tfrac{1}{2}(q_1 - q_3) = \left[\frac{\tfrac{1}{2}(c+d)}{ad-bc}\right]V_{12} - \left[\frac{\tfrac{1}{2}(a+b)}{ad-bc}\right]V_{23} \quad (139)$$

$$\left.\begin{aligned} \tfrac{1}{2}(c+d) &= \log\frac{d_{12}d^2_{23}}{r_2 r^2_3 d_{12}} \\ \tfrac{1}{2}(a+b) &= \log\frac{r_2 d^2_{12}}{r_1 d^2_{23}} \end{aligned}\right\} \quad (140)$$

There are two similar solutions for the other two combinations of pairs, which can readily be worked out. It is not necessary to do so, however, for purposes of calculation, as a rotation of the conductor numbers on the diagram is sufficient.

When the three conductors are disposed in one plane the system is unbalanced electrostatically, as already shown in a previous case. If, however, the conductors are situated at the corners of an equilateral triangle, the system here becomes perfectly balanced.

In this case,

$$\left.\begin{aligned} r_1 = r_2 = r_3 = r \\ d_{12} = d_{13} = d_{23} = d \end{aligned}\right\} \quad (141)$$

whence

$$a = -b = c = \tfrac{1}{2}d = 2\log\frac{d}{r} \quad (142)$$

and (139) reduces to

$$\tfrac{1}{2}(q_1 - q_3) = \left(\frac{1}{4\log\dfrac{d}{r}}\right)V_{12} \quad (143)$$

and the coefficient of capacity is identical with that for a single pair of equal conductors. Thus it is a simple matter to find the charging currents per phase of a delta three-phase system when the line is arranged as shown in Fig. 16.

These formulas in general apply, of course, to the simple case of continuous emfs, and also to the instantaneous charges and emfs in a single-phase system, or to the effective values. They apply equally to the instantaneous values

Fig. 16—Three-Wire Insulated System Grouped for Electrostatic Balance.

in a polyphase system. Under these circumstances all operations are of a scalar character.

But in a vector sense they are just as true for the effective charges and emfs of a polyphase system, so that (138) and (139) are perfectly general for continuous emfs or for sinusoidal alternating emfs, single-phase or polyphase, when regarded as vector equations. The charging currents with sinusoidal emfs follow directly from

$$i = \frac{dq}{dt} \quad (144)$$

which simply amounts to the complex imaginary operator $\pm j$, where the sign depends upon the assumption in regard to positive and negative directions of rotation.

MIXED GROUNDED AND METALLIC CIRCUITS.

There is nothing really new in cases of this sort, because the principles already developed apply here also. It seems unnecessary to work out a general case, because the general process can be illustrated very well by a simple case.

Three Wires.—The simplest case comprises three wires arranged as one grounded circuit and one metallic circuit. Let wires *1* and *2* comprise the pair and *3* the grounded circuit. Starting with the fundamental equations given in (126), the limiting condition is given by

$$q_1 + q_2 = 0 \quad (145)$$

whence

$$\left.\begin{aligned} V_1 &= (u_{11} - u_{12})\,q_1 + u_{13}q_3 \\ V_2 &= (u_{12} - u_{22})\,q_1 + u_{23}q_3 \\ V_3 &= (u_{13} - u_{23})\,q_1 + u_{33}q_3 \end{aligned}\right\} \quad (146)$$

and

$$\left.\begin{aligned} V_{12} &= (u_{11} - 2u_{12} + u_{22})\,q_1 + (u_{13} - u_{23})\,q_3 \\ V_3 &= (u_{13} - u_{23})\,q_1 + u_{33}q_3 \end{aligned}\right\} \quad (147)$$

Solving for the charges,

$$\left.\begin{aligned} q_1 &= C_{12}V_{12} + C_{123}V_3 \\ q_3 &= C_{123}V_{12} + C_3 V_3 \end{aligned}\right\} \quad (148)$$

where

$$C_{12} = \frac{2\log\dfrac{2h_3}{r_3}}{\left(2\log\dfrac{d_{12}^2}{r_1 r_2}\right)\left(2\log\dfrac{2h_3}{r_3}\right) - \left(2\log\dfrac{d_{23}}{d_{13}}\right)^2} \quad (149)$$

$$C_3 = \frac{2\log\dfrac{d_{12}^2}{r_1 r_2}}{\left(2\log\dfrac{d_{12}^2}{r_1 r_2}\right)\left(2\log\dfrac{2h_3}{r_3}\right) - \left(2\log\dfrac{d_{23}}{d_{13}}\right)^2} \quad (150)$$

$$C_{123} = \frac{-2\log\dfrac{d_{23}}{d_{13}}}{\left(2\log\dfrac{d_{12}^2}{r_1 r_2}\right)\left(2\log\dfrac{2h_3}{r_3}\right) - \left(2\log\dfrac{d_{23}}{d_{13}}\right)^2} \quad (151)$$

It is obvious that if conductor *3* is so placed that $d_{13} = d_{23}$ the mutual capacity will vanish and the capacity of each circuit will have the same value as it would if the other circuit were not present.

Two Wires; Grounded Phantom.—Two wires are frequently employed in telephony to secure one metallic circuit and one grounded phantom circuit by familiar methods. In this case the fundamental equations are,

$$\left.\begin{aligned} V_1 &= u_{11}q_1 + u_{12}q_2 \\ V_2 &= u_{12}q_1 + u_{22}q_2 \end{aligned}\right\} \quad (152)$$

and the limiting condition is

$$V_1 = V_2 \quad (153)$$

whence

$$-q_2 = \left(\frac{u_{11} - u_{12}}{u_{12} - u_{22}}\right)q_1 \quad (154)$$

and

$$V_1 = \left[\frac{u_{11}(u_{12} - u_{22}) - u_{12}(u_{11} - u_{12})}{u_{12} - u_{22}}\right]q_1 \quad (155)$$

But,

$$\begin{aligned} q_1 + q_2 &= \left(1 - \frac{u_{11} - u_{12}}{u_{12} - u_{22}}\right)q_1 \\ &= \left[\frac{-(u_{11} - 2u_{12} + u_{22})}{u_{12} - u_{22}}\right]q_1 \end{aligned} \quad (156)$$

so that,

$$\begin{aligned} V_1 &= \left[\frac{u_{11}(u_{12} - u_{22}) - u_{12}(u_{11} - u_{12})}{-u_{11} + 2u_{12} - u_{22}}\right](q_1 + q_2) \\ &= \left[\frac{u_{11}u_{22} - u_{12}^2}{u_{11} - 2u_{12} + u_{22}}\right](q_1 + q_2) \end{aligned} \quad (157)$$

and finally

$$C_{1+2}=\frac{\left(2\log\frac{4\,h_1h_2d_{12}^2}{r_1r_2h_{12}^2}\right)}{\left(2\log\frac{2\,h_1}{r_1}\right)\left(2\log\frac{2\,h_2}{r_2}\right)-\left(2\log\frac{h_{12}}{d_{12}}\right)^2} \qquad (158)$$

Except in a special case, to be mentioned, there will theoretically be conductive interference between the physical circuit and the phantom, caused by unequal charging currents in the two conductors from the emf impressed on the phantom. This can be neutralized by transposition, of course.

However, a natural balance will exist when,

$$\left.\begin{aligned} r_1&=r_2=r\\ h_1&=h_2=h\end{aligned}\right\} \qquad (159)$$

In that case

$$q_2=q_1 \qquad (160)$$

and

$$C'_{1+2}=\frac{2}{\left(2\log\frac{2\,h\sqrt{d^2+4\,h^2}}{rd}\right)} \qquad (161)$$

The capacity in this case is considerably more than the capacity of either conductor, alone, to earth; at the same time it is less than twice the capacity of either conductor alone. So that the attenuation over the phantom will be less than the attenuation over a grounded circuit composed of one of the single conductors.

The calculation of capacity coefficients for more complicated cases of this general character might be extended almost indefinitely, but the principles involved have been fully covered. The great variety of possible cases makes it inadvisable to attempt a more extensive treatment.

CALCULATION OF CONSTANT.

The capacity coefficients deduced throughout this treatment are in terms of c.g.s. electrostatic units per centimeter length of conductor; natural or Napierian logarithms are also implied in every case. In order to change the results to electromagnetic units and finally to practical units, it is necessary to calculate the value of the proper factor or constant.

The value of the constant for obtaining the result in microfarads per mile, using common logarithms, is

$$K=\frac{10^{15}n}{v^2m} \qquad (162)$$

where,

10^{15} = factor to change from c.g.s. electromagnetic units of capacity to microfarads.

n = 160,930, or the number of centimeters in one statute mile of 5280 ft.

$v=3\times10^{10}$, or the velocity of light, being the factor to change from electromagnetic to electrostatic units of capacity.

m = 2.3026, or the factor to change common logarithms to Napierian logarithms.

The value of the constant is,

$$K=0.07766 \qquad (163)$$

For microfarads per 1000 ft. the value of the constant is

$$K'=0.014708 \qquad (164)$$

These constants apply to every coefficient of capacity deduced by the methods heretofore employed. In every case where numerical values have been presented the unit is microfarads per mile.

LIMITATIONS OF METHOD.

The general method here used depends fundamentally upon the exactness of the potential coefficients. Given, in any case whatever, an exact expression, or form of expression, for the potential coefficient, the methods heretofore used are rigid.

As stated very much earlier, the form of the potential coefficient actually employed is not precise when the separation between the conductors is small compared with their diameters—that is, when $\frac{d}{r}$ is not large. In most cases of suspended bare wires, however, the value of $\frac{d}{r}$ is rather large; in such cases there is no appreciable error whatever in assuming that the surface distribution of the charge on each conductor can be represented by an equal charge with linear distribution along the axis of the conductor.

For values of $\frac{d}{r}$ which are small and the corresponding formula for capacity in simple cases the reader should consult an article in the *Electrical World* of Sept. 22, 1910, by Messrs. H. Pender and H. S. Osborne, on "The Electrostatic Capacity Between Equal Parallel Wires," and another article by Dr. A. E. Kennelly, Oct. 27, 1910, on "Graphic Representations of the Linear Electrostatic Capacity Between Equal Parallel Wires." These articles deal with the exact formula when $\frac{d}{r}$ is small, in the case of a pair of equal wires charged from an insulated source, and also show the error under such conditions of applying the formula deduced in the present instance.

It is proper to point out, also, that the present treatment does not apply to insulated wires if the specific inductive capacity of the insulation differs from unity. Ordinarily it is greater than unity and causes an increase in the coefficient of capacity. For example, if conductor *1* is insulated to a radius r_3 and conductor *2* to a radius r_4, where k is the specific inductive capacity of the insulation, then

$$C_{12}=\frac{1}{2\left(\frac{1}{k}\log\frac{r_3r_4}{r_1r_2}+\log\frac{d_{12}^2}{r_3r_4}\right)} \qquad (165)$$

and for a single insulated conductor, insulated to a radius r_2,

$$C_1=\frac{1}{2\left(\frac{1}{k}\log\frac{r_2}{r_1}+\log\frac{2\,h}{r_2}\right)} \qquad (166)$$

It will be observed that when the insulation thickness becomes zero, or when k equals unity, these expressions reduce to the simple and familiar form for bare wires. In general, the effect of insulation complicates the problem, besides increasing the capacities.

COST COMPARISON OF SMALL GAS-ENGINE AND STEAM PLANTS.

In a recent discussion of internal-combustion engines for power stations Mr. R. M. Carr, chief electrical engineer for the Leek (England) gas-engine-driven generating station, enumerates the comparative costs of operating steam and gas-engine plants. The higher investment in a gas-engine plant has been urged against this form of motive power, and, although the author admits this objection when bearing upon large units, especially turbines, he

	500 Kw. or Under.	500 Kw. to 1000 Kw.	1000 Kw. to 2000 Kw.
Steam:			
Engines, generators, boilers, auxiliaries, switchboard, battery, piping, crane, etc. Cost installed per kilowatt	$180.00	$130.00	$100.00
Land, buildings, shaft, foundations	95.50	59.00	47.50
Total cost per kilowatt	$275.50	$189.50	$147.50
Gas:			
Engines, generators, producer plant, switchboard, battery, piping, crane, etc.	$140.00	$122.00	$110.00
Land, buildings and foundations	60.00	45.00	42.50
	$200.00	$167.00	$152.50

declares that for small plants up to a certain rating the gas-driven station costs less than steam.

For plants under 500 kw in rating he estimates costs as given in the table on the preceding page, the equivalent of his figures being stated in United States money.

These figures as given are the averages from actual costs of a number of stations up to 500-kw rating. The gas-engine figures above 500 kw were taken from manufacturers' estimates, says the author. His own plant at Leek cost as follows:

Engines and generators	$32,835	
Producer plant, piping, etc.	10,350	
Switchboard	6,960	
Battery	3,595	
Crane	945	
Total	$54,685	
Cost per kilowatt installed		$130
Land, buildings, etc.	$27,065	
Cost per kilowatt		$65
Total cost per kilowatt		$195

While it is usually acknowledged that the fuel costs of a gas-driven plant are considerably below those of a similar steam plant, other items must be taken into account in making comparison. Particularly is this the case in repairs and maintenance of engines, which, in the author's opinion, will be somewhat greater after a few years of running for gas engines than for steam. Of course, the thermal efficiency of a gas plant is admittedly much better than that of steam, but, as the author continues, the advertised figures of some makers of gas engines, while they may possibly be true with the conditions under which the tests were taken, are seldom, if ever, realized under ordinary working conditions, and it is impossible to get anything like such results with the fluctuating load of the average central station.

On the other hand, the repairs to a well-designed producer plant should not be nearly so great as those of boilers. For purposes of comparison, however, there have been taken the figures of three municipal plants, each entirely gas-driven, the averages of several others, also gas-driven, and these are compared with the average of all the municipal undertakings of a capacity under 1000 kw. Where the figures given were per kw-hour generated, 20 per cent has been deducted to allow for losses in transmission, energy used in station, battery losses, etc., so that the figures shall fairly represent the costs per kw-hour sold.

COMPARISON BETWEEN GAS AND STEAM STATIONS UNDER 1000-KW RATING.

	Averages of Municipal Gas-Engine Plants.	Averages of Other Gas Stations.	Averages of Steam Stations.
Rating in kilowatts	314	632	600
Kw-hours sold per annum	299,210	874,720	502,980
COST IN CENTS PER KW-HOUR SOLD.			
Fuel	0.56	0.52	1.06
Oil, waste, water and stores	0.12	0.08	0.12
Wages of workmen	0.52	0.32	0.60
Repairs and maintenance	0.38	0.44	0.56
Total works costs	1.58	1.36	2.34
Rent, rates and taxes	0.20	Not available	0.24
Management and establishment charges, insurance, etc.	0.82	Not available	0.68
Total costs	2.60	....	3.26

The average price for fuel in the municipal stations quoted is $2.54 per ton delivered, either coke or bituminous coal being used. It will be noted that the repairs and maintenance item for the gas stations is not so high as that of steam. It may be attributed in part to the gas stations not having been in operation so long as the steam plants, but, notwithstanding the heavy wear and consequent repairs to be expected in gas engines, it is questionable whether this will ever exceed the total repair bill on steam engines and boilers.

Central Station
Management, Policies and Commercial Methods

GAS HOLDER USED IN COOLING-TOWER AT HOT SPRINGS, ARK.

The power house which produces electrical energy for lighting and railway purposes at Hot Springs, Ark., has heretofore used the run-off water from the famous hot springs as the only available supply for condenser purposes. The temperature of this water averages 80 deg. Fahr. in summer. To augment the supply, as noted in the *Electrical World* of May 26, 1910, a pumping station was installed 2 miles further up the stream bed into which the hot springs discharge, and a large addition thus made to the natural flow.

Natural gas has now been piped into Hot Springs, and the local company, which furnished all the utilities for the town, will distribute this gas to its former artificial-gas consumers, besides burning it under the boilers of its power station. The advent of natural gas into Hot Springs has accordingly released from further duty the 90-ft. holder tank used in connection with the artificial-gas plant. and this receiver is now being adapted for use as a cooling tower in connection with a new condenser just installed. The water-seal pit is used as the receiving tank, while Koerting sprays are arranged to throw streams of water over the sides and top of the tank. After being cooled by evaporation, this water returns to the seal pit. No other changes have been made in the gas holder, which may be required for use should the natural-gas supply fail. Meanwhile the holder serves as a very effective cooling tower. Mr. R. Schwartz is general superintendent of the Hot Springs Water Company, and Mr. A. E. Main is superintendent of its electrical department.

HOUSE-WIRING RESULTS AT SHREVEPORT.

The Shreveport (La.) Gas & Electric Company has inaugurated a new-business campaign, a feature of which is the wiring of old houses on an instalment plan, according to which the customers are required to pay $2 down and $2 per month. This cost refers to both concealed and open work, and the proposition is tendered to all houses remaining unwired that are reached by the company's pole lines. The electric company meets the cost of construction and then collects from the customer at the rates above mentioned, the amounts being added to the monthly electric service bills. The contract between the company and the consumer stipulates that the consumer shall immediately begin the use of electric service following the completion of the installation. Shreveport is a city of

31,000 population, and has 2600 electrical consumers. As the result of the house-wiring campaign, seventy-five new consumers were obtained in thirty days. The instalment feature of the scheme has proved especially attractive in getting new business, and the results obtained have been gratifying to Mr. J. E. Cowles, superintendent of the lighting department of the Shreveport Gas & Electric Company

ELECTRIC SIGNS IN MILWAUKEE.

In the organization of the new sales department for the Milwaukee Electric Railway & Light Company, headed by Mr. C. N. Duffy, who is comptroller of the company, special attention was paid to the matter of display and sign

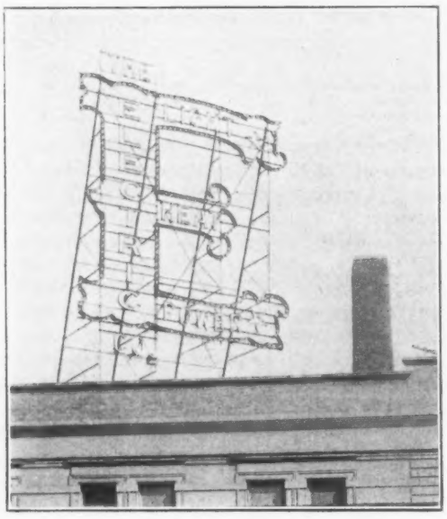


Fig. 1—Milwaukee Electric Company's Monogram Sign on Power House.

lighting, two specialists in these lines being provided for. The results of this new-business campaign are already in evidence on the streets of the city, where in spite of the restrictive sign ordinance a number of handsome displays

Fig. 2—Curb and Sign Lighting of Milwaukee Public Service Building.

have been erected. Milwaukee's city fathers limit all electric signs to positions flat on the walls of buildings, and this restriction has hampered the location of many installations.

At the beginning of its sign campaign the electric company itself led off with the erection of a handsome 40-ft. monogram sign containing 540 lamps on the top of its Oneida Street power plant, as shown in Fig. 1. This sign is 32 ft. high and 30 ft. wide, and stands 40 ft. above the roof. The symbol is that used generally by the company and is familiar to Milwaukee people. The sign is provided with alternating-current service, and by means of a flasher first the large "E" is made to appear, followed in turn by the words "The Electric Co.," "Light," "Heat" and "Power."

Fig. 3—A Milwaukee Manufacturer's Appeal to Citizens' Pride in Home Products.

Fig. 2 shows the attractive display erected by the central-station company on its handsome Public Service Building. The ball at the top of the sign is kept in motion by a flasher and the effect of the sign is not lost even in contrast with the brilliant electric curb lighting maintained by the Milwaukee company in front of its offices.

Fig. 3 shows a sign erected by a local manufacturer to appeal to the citizens of the community which his own product is reputed to have made famous. Another striking spectacular sign in Milwaukee is a small-sized reproduction of the famous chariot-race sign displayed in New York, Detroit and Dayton. The Milwaukee sign was erected by the enterprise of a local merchant who operates the display entirely in his own interests. This chariot-race display, the electric company's big "E" and a number of other signs find an unusual and effective setting against the dark background of the buildings abutting on the Milwaukee River, which bisects the city. At the Wisconsin Avenue bridge the main arteries of travel are concentrated, so that a large number of persons are continually passing in view of the electric displays.

ELECTRIC AUTOMOBILES AT DENVER.

Electric pleasure vehicles have attained great popularity in the city of Denver, Col., there being over 800 in regular service at the present time. It is estimated that one family in every sixty is the owner of an electric runabout, phaeton or coupé, and the Denver Gas & Electric Light Company is now deriving a total yearly revenue from the sale of energy for charging of about $43,600. The energy con-

sumption is now at the rate of 2,180,000 kw-hours per annum, and the greater part of this business is handled off the company's peak. Each vehicle is producing a revenue for the central-station organization of about $54.50 a year, or a little over $1 a week.

There are at present fifteen garages making a specialty

Fig. 1—Parade of Electric Trucks.

of electric-vehicle service, and the rates vary from $20 per month per car upward, the lowest price being charged for vehicles maintained in the garages but not delivered to or returned from owners by the garage staff. Garage charges cover the supply of energy to the batteries, washing, oiling, minor adjustments and general cleaning and supervision. The popularity of the electric machines is evidenced by their almost continuous appearance on the streets, and in the residential sections of the city it is difficult to walk more than two or three blocks without passing an electric pleasure vehicle. Long rows of these equipments line the important side streets of the shopping district and there is little question that they illustrate the most popular type of car for town service. Runs into the country and hilly districts outside the city are becoming frequent, and the trip from Denver to Colorado Springs, a distance of 75 miles, including the passage of the divide between the Platte and Arkansas Valleys, is not seldom made on a single charge.

The Denver Gas & Electric Light Company owns nine electric vehicles, ranging in size from a light runabout to a 3.5 ton truck for delivering coke about the city. These

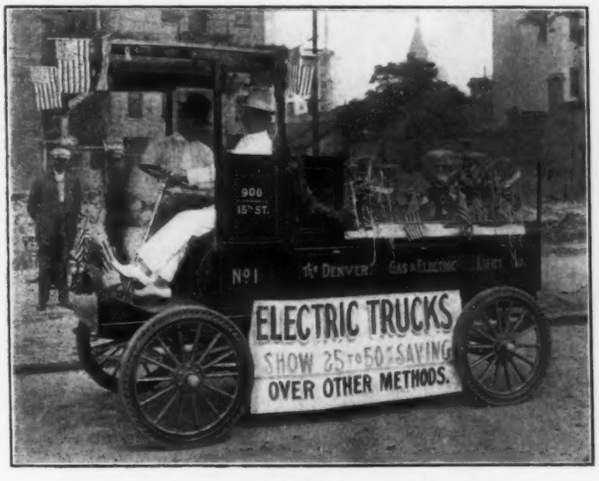


Fig. 2—Small Truck Advertising Electric Fans.

machines are charged and maintained at a garage operated by the company near its West Side power station. The garage is strictly private and handles no commercial business, although its staff is constantly at the service of the commercial garages in matters requiring consultation, emergencies and difficulties occurring in operation. The garage also maintains forty-eight motor cycles used by the company's inspectors and trouble men in meeting emergency calls and twelve gasoline cars used in long-distance service. The garage is open twenty-four hours a day and seven days a week. It contains facilities for the simultaneous charging of eighteen electric vehicles, a stockroom, machine shop and battery maintenance department. At present the work of charging is handled by a 25-kw, 150-volt generator direct-driven by a 40-hp, 2300-volt, three-phase induction motor. A new motor-generator set of 100-kw rating will shortly be added. All the wiring is in conduit and the charging service is controlled by a switchboard of five panels, two panels being equipped for motor-generator control and three for the control of charging circuits. The arrangements permit the charging of any vehicle with or without an ammeter in series with the battery, and the usual plug receptacles for voltmeter measurements are installed. Each of the eighteen charging circuits is provided with a rheostat which is installed behind and above the switchboard on an angle-iron framework. All circuits are fused at the board and at the wall outlet. The outlets are arranged to permit the sudden withdrawal of the charging plug without short-circuiting. The machine shop contains an engine lathe, a drill press and a grinder group driven by a 3-hp induction motor. Ten thousand battery plates are carried in stock by the company. Battery boxes are manufactured for the company's service in the garage, and the woodwork is paraffined with the aid of an electric flatiron to protect it from liquid damage.

Many electric vehicles were exhibited during an industrial parade held in Denver on July 18, and every type of machine owned by the company was in line. The electric division of the parade was headed by a 2-ton construction truck used in line service, this being fitted up to represent various features of an electric home. Electric washing machines were demonstrated with genuine soapsuds by two young ladies, electric flatirons were operated as the procession passed along the streets and an electric piano was in service on the truck. Energy for the operation of this equipment was obtained from the storage battery propelling the truck, additional cells being connected in series to furnish the necessary voltage. Another electric vehicle used in meter service was equipped with electric fans. Other trucks were provided with flags, signs and other decorations calling attention to the average saving of 25 per cent to 50 per cent in transportation effected by the electric vehicle.

Most of the prominent makers of pleasure vehicles of the electric type are represented in Denver, and at present a vigorous campaign is being made to acquaint the public with the economies of the electric truck. The streets of Denver are well paved and characterized by moderate grades, and the climate is favorable to continuous electric-vehicle service throughout the entire year. Gasoline trucks have been adopted to some extent in Denver, but the Denver Gas & Electric Light Company is planning to compete against these through the work of its electric-vehicle department in educating the public to the better understanding of the possibilities of the electric truck. There is little doubt that the success attained in the use of electric pleasure cars will count heavily in favor of this type of truck in Denver.

Among the prominent garages that of the Fritchle Automobile & Battery Company has a representative equipment of motor-driven machinery for washing, cleaning and charging service, including a 50-kw motor-generator set for night work in charging batteries and smaller generators for day service. This company manufactures electric pleasure vehicles, producing every part of its cars except tires and lamps, and it operates a large plant on the garage premises in which all the machining, carpentry, upholstery and assembling work required in the manufacture of vehicles are handled. All the machine tools on the premises

are motor-driven. Each vehicle is supplied with a 4-hp laminated-field, direct-current motor and a battery of the Fritchle type, the motor being capable of being operated for short periods at 400 per cent overload. The latest coupés built by this organization are equipped with automatic switches by which the interior lamp is lighted by the opening of the door, and it is also provided that the motors shall return electricity to the batteries in descending grades. The garage has a capacity of 250 cars, and 135 vehicles of this make are now in service in Denver. The company has lately taken up the question of commercial electric-truck development and will shortly enter this field.

Other prominent garages in service are the three electric-vehicle stations of the Carstarphen interests, and those of the Krebbs-Gotschall, Capitol Hill, Davis, and Denver Omnibus & Cab interests. The last-named establishment has three electric sight-seeing trucks seating twenty passengers each, and a baggage truck which recently delivered fifty-five sample trunks weighing over 200 lb. each and thirty suitcases on a single trip. The sight-seeing cars make about forty-five miles daily, individually, upon one battery charge each and their cost of operation is one-fifth that of the former gasoline vehicles used in this service. The Denver Gas & Electric Light Company's coke truck recently delivered 26 tons of fuel in one day, only one man being required for the service. There are about 125 private garages in Denver, the rate for a 30-amp rectifier on off-peak service being 4 cents per kw-hour, less 10 per cent discount for prompt payment, the minimum charge being $5 net per month. If charging is done at the time of the peak on the lighting company's system, the rate per kw-hour is the same, but the monthly minimum becomes $7.50. Commercial garages are given a rate based on the horse-power connected—$24 per year per horse-power plus 3 cents per kw-hour as metered, with a 10 per cent discount. In addition, a so-called consumer's charge of 75 cents per month is imposed.

CENTRAL-STATION COMMERCIAL ENGINEERING.

In a paper read at a joint meeting of the Milwaukee Engineering Society and the Milwaukee Section of the American Institute of Electrical Engineers Mr. Egbert Douglas gave many interesting hints relating to central-station commercial engineering. Below is given an abstract of his suggestions bearing on motor and heating applications.

MOTOR APPLICATIONS.

The expiration of practically all broad patent claims on motor designs has brought the cost of electric motors down to the point where their use for factory driving is well within the required limits of first cost to compete successfully with the now obsolete mechanical drive. These conditions might seem to simplify greatly the task of the user in making selection and purchase of proper factory equipment. As a matter of fact, however, the situation is inclined to become more complicated. Some of the reasons for such complication are as follows:

To the inexperienced user of motors there is a strong inclination to employ too many motors and subdivide the load too far. As a general proposition the use of individual motors is easily overdone, with the result that: (a) the first cost of equipment is readily increased beyond the point of profitable investment; (b) the saving in energy is often widely overestimated by the use of individual motors; (c) the use of individual-motor drive in some industries tends to increase rather than decrease the amount of energy—this is particularly true in cotton mills. In this class of industry, however, the increased energy is of little moment, as the increase in production readily overcomes the increase in energy at a handsome return.

As an indication of how easy it is to overdo the individual-motor drive it was once suggested that the proper way to equip a cotton mill would be to put a motor on every spindle. Imagine a cotton mill with 50,000 spindles equipped with 50,000 motors!

There are industries, however, where individual-motor applications are very desirable without regard to either saving in energy or increase in production. The uniformity of speed necessary for successful operation will justify their use. Other conditions are encountered where individual motors are desirable solely on account of conditions of cleanliness; for instance, in a laundry or printing shop, where the elimination of overhead shafting and belts is the means of removing much undesirable dirt.

Certain applications where the nature of the machine would indicate the group method as being preferable on account of rapidly fluctuating load conditions are overbalanced by the nature of the finished product. For example, a ribbon loom takes little power and gives rather an erratic load, and as far as load is concerned grouping is desirable. The nature of the product, however, is such that belts are undesirable, as the frictional electricity from them tends to distort the silk threads and makes the fabric crooked. On account of high cost of material few second grades can be tolerated, with the result that individual motors are here very desirable.

The amount of power is often overestimated, and in the absence of accurate information on average commercial load conditions often plants are provided with too large motors, and, again, they may be equipped with too small motors. With the desire to be safe, however, the motors are more usually too large than too small. This result probably is due to giving insufficient attention to the time-factor of machines or groups of machines or to the nature of the plant and character of material used. For example, a 36-in. lathe in a manufacturing plant used for roughing shafting of low-carbon steel and taking two cuts at a speed of 150 ft. per minute will require 25 hp. The same lathe in another plant used for finishing or repair work would require only from 3 hp to 5 hp.

In large factories where competition is keen the tools are worked much harder than in repair shops and small plants, and hence the motor requirements are radically different from those for the same tool in different industries.

Again, the cycle of operation of machines where the duty is intermittent should be given careful consideration in selecting the motor, to secure proper sizes and resultant heating.

Consider an application requiring 50 hp for 5 minutes and 10 hp for 10 minutes, the operation being repeated every 15 minutes. The average load of the motor is:

$$50 \times 5 = 250 \text{ hp-min.}$$
$$10 \times 10 = 100 \text{ hp-min.}$$
$$\text{Total, } 350 \text{ hp-min.}$$

the time average being 23.3 hp.

This average load will not produce the same heating that the cycle will, for the reason that the copper losses in the motor vary as the square of the current. The root mean square or equivalent heating will be produced by the following:

$$50^2 \times 5 = 12{,}500$$
$$10^2 \times 10 = 1{,}000$$
$$\text{Total, } 13{,}500$$

Dividing this over 15 minutes the average square is found to be 900, the square root of which is 30. Thus a root-mean-square load of 30 hp if applied continuously will produce the same heating as the cycle.

In machine-tool applications where the cutting is intermittent, such as planers, shapers, slotters, etc., the maximum load almost invariably comes when the reverse movement is made from the cutting stroke.

The central-station commercial engineer finds it difficult with inexperienced motor users to prevent them in such cases from purchasing motors rated equal to the maximum load.

Again there are applications where the load is on a

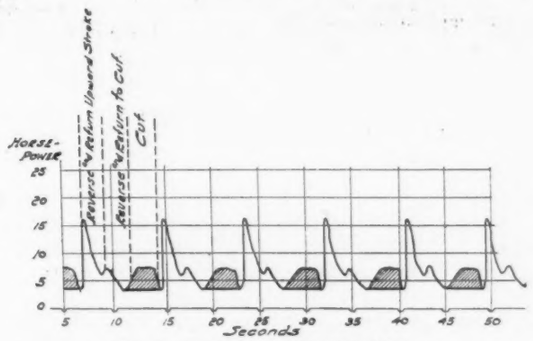


Fig. 1—Cycle of Slotter Operation.

motor for, say, from an hour to an hour and a half once a day, such as in a small gray-iron foundry cupola. In such a case where the load is carried by a cold motor a 20 per cent or 25 per cent overload on the motor would be conservative, as the motor would hardly reach its permissible temperature when the work would be finished.

The following two examples show some of the principles forming the basis of analysis of the comparative cost of operating group and individual drives.

Machine Shop.—It is proposed to equip with electric motors a machine shop now being driven by a 150-hp steam engine and 800 ft. of main-line shafting kept in excellent condition. Indicator cards showed:

Indicated horse-power of engine	111
Indicated horse-power friction of shafting	35

The comparative investment and operating costs are shown in the following table:

	Group Drive.	Individual Drive.
Number of motors	1	217
Aggregate rated horse-power	150	450
Initial cost of drive	$4,000.00	$25,000.00
Yearly cost of maintenance	$1,750.00	$1,280.00
"Fixed charges"	$600.00	$3,750.00
Annual consumption, kw-hours	240,000	132,200
Cost of energy at 4 cents per kw-hour	$9,600.00	$5,288.00
Total annual cost	$11,920.00	$10,318.00

If the energy costs less than 3.6 cents per kw-hour, the total cost of operating the group-drive installation would be less than that of operating the individual drive.

Shirt Factory.—It is proposed to equip the 149 sewing

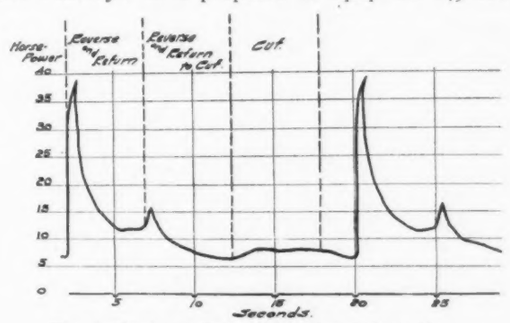


Fig. 2—Cycle of Open-Side Planer Operation.

machines in a shirt factory with electric drive. For comparison the actual results in another factory manufacturing the same quality and line of goods, but equipped with 174 sewing machines, are known.

The comparative investment and operating costs of the three equipments are shown in the following table:

	Shaft Drive.	Group Drive.	Individual Drive.
Number of machines	174	149	149
Number of motors	2	5	149
Aggregate rating of motors, horse-power	28	25	24.8
Friction load, kilowatts	9.7	5.0	...
Initial cost of drive	$1,000.00	$1,400.00	$4,500.00
Yearly cost of maintenance	$30.00	$50.00	$125.00
"Fixed charges"	$150.00	$210.00	$675.00
Annual consumption, kw-hours	42,600	24,240	22,700
Cost of energy at 4 cents per kw-hour	$1,704.00	$969.60	$908.00
Total annual cost	$1,884.00	$1,229.60	$1,708.00

From the foregoing table it appears that the five-motor group is more economical than either the two-motor group or the individual drive if the cost of electric energy is 4 cents per kw-hour. The group drive with two motors is more economical in total annual cost than the individual drive if the cost of energy is less than 3.3 cents per kw-hour and more economical than the five-motor group if the cost of energy is less than 0.6 cent per kw-hour.

HEATING APPLICATIONS.

The general subject of the application of electric heat is divided into two classes, namely, domestic applications and industrial applications. Both these classes of applications

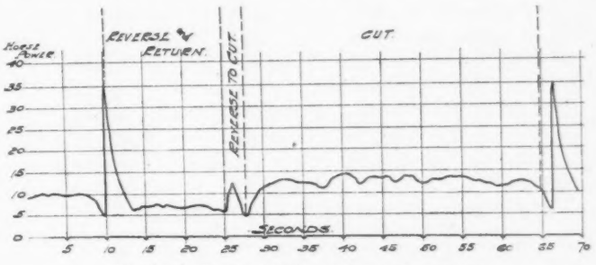


Fig. 3—Cycle of 120-in. Planer Operation.

of electric heat are now receiving well-merited attention from central-station commercial engineers, since the former has an important bearing on the financial results of distributing electric energy in a residence district and the latter sometimes influences the use of central-station service in place of privately produced energy.

Domestic Applications.—The price at which electric service can be profitably sold is dependent largely on the density of the business and the load-factor such business produces. In a city with the residence-lighting business only moderately developed it is probable that the business is being done with only a very small return on the investment devoted to such business. This result is attributable to the relatively low density of business—that is, to the small amount of energy per mile of line and to the low load-factor developed by this class of business. Any use of electricity that will tend to increase the density and load-factor of the residence-lighting business is looked upon with favor by central stations.

The first domestic electric-heating device that found a large use was the smoothing "iron." Following closely upon the development of this device came other heating devices, such as chafing dishes, coffee percolators, water heaters, heating pads and toasters. The principal argument for the use of these devices is that of their convenience. At the rates at which electric service can be sold under the present condition of residence-business development these services cannot be said to compete with other means of producing heat and their use is another example of the willingness of people to pay for convenience.

The electric stove or cooker is now assuming a prominent field in the mind of central-station operators. Much

has been done in the development of the design of such stoves, but their actual use is not large as yet. In the ordinary electric stove the heat is produced only when needed. Under such conditions of use the maximum demand imposed on the distribution system is high and the load-factor low. Moreover, the time of the maximum demand coincides with that of the commercial-lighting peak. The ordinary stove accordingly does not meet the requirements of central stations in improving the residence load-factor.

When this condition was fully appreciated attention was directed to a type of stove that would use electric energy at a low rate through a large number of hours each day, store the heat thus produced in a heat-absorbing medium, such as cast iron or zinc, and give off heat at such rate as was necessary to perform the cooking process. This method has thus far been applied only to the oven of the stove in which roasting or baking is done.

Along this line there has been developed in England the so-called "Therol" system of heat storage and in connection therewith a few devices for making use of the heat so stored. In these devices the heating elements are embedded in a block of cast iron or zinc, which forms the heat-storage medium. In the case of the water heater the iron or zinc is cast around a coil of the pipe into which passes the water to be heated. The insulating medium consists of magnesia and outside the magnesia is a water jacket, etc.

The future development of electric-cooking apparatus seems to be rather largely dependent upon the discovery of a heat insulator or device that will retain its insulating qualities at the high temperature necessary for the storage of an appreciable amount of heat in a moderate-sized mass of material. So much effort is now being directed along this line that success in the near future is not at all improbable. Most central stations are awaiting the further development of the electric range with heat-storage system before undertaking the commercial application of the device.

Industrial Heating Applications.—Aside from the interest in industrial heating appliances arising out of the extensions of the field of electric service by their use central stations are interested in such appliances, as in many cases they assist in handling the isolated steam-plant problem. One of the difficulties often confronting those putting into practice the gospel of central-station electric service is the requirement of a small amount of live steam for heating in some part of the industrial process. In many such cases electric heat can be applied with good economy and increased output or saving in time and with better factory working conditions.

The field for the introduction of electrical heat for industrial purposes is a wide one and covers an enormous variety of applications in which steam and direct-combustion methods are now used. The adoption of electric heat presents many of the advantages over the older methods that the electric drive does over the mechanical system of transmitting energy. Safety, cleanliness and flexibility are as apparent as in the motor applications. Increased production, improved product and decreased manufacturing costs are also included in the results obtained by its use.

New industries have been created by the aid of electric heat through processes possible only by this method. Some of the industries which present opportunities for its use are embossing and matrix drying and heating glue in paper-box industries and furniture factories. In the leather trade it finds a ready application for heating the large variety of tools required in finishing and ornamentation. In laundry work it has been found preferable for ironing even in the natural-gas belt. In the celluloid industry, the clothing industry and textile trades its use has been found desirable. Bakers and confectioners are inviting prospective customers for its adoption.

As an example of the advantages it has over live steam may be cited matrix drying in the newspaper industry. In this work temperatures as high as 450 deg. Fahr. may be safely used and, since time is a very important factor in getting out extra editions, this high temperature is very desirable as it minimizes the time required to dry a matrix. To secure this high temperature requires such high steam pressure that the use of electric heat has proved its superiority. The steam pressures required for various temperatures are as follows:

Steam Pressure, Pounds per Square Inch.	Temperature, Degrees Fahrenheit.
352	125
361	140
385	195
400	235
456	435

It is readily seen from the above that prohibitive steam pressures are reached long before the desirable temperatures are approached.

The matrix-drying apparatus can be kept warm in many cases by using energy at times when energy is not being used for other purposes, which arrangement under modern rates secures the energy for the heating at relatively low rates on account of the improved load-factor.

Wiring and Illumination

INDIRECT LIGHTING OF AN ARCHED CHURCH INTERIOR.

Several unique features of indirect and projected illumination, means of reaching fixtures for cleaning, etc., are incorporated in the lighting arrangements of the handsome new church building of the North Chicago Hebrew congregation, of Chicago, Ill.

The main auditorium, which is lighted entirely by concealed tungsten units, measures 70 ft. x 88 ft. in plan, and, as shown in the illustration, has its ceiling divided into a central barrel arch, 48 ft. wide and 50 ft. from floor to crown, and two flat-ceilinged panels each 20 ft. x 70 ft. and 30 ft. above the floor. The central span is lighted by fifty-two 100-watt lamps, twenty-six on a side, inclosed in helmet reflectors and concealed behind the two girders bordering the arch. As shown in the sketch, these helmet reflectors have their axes inclined about 15 deg. to the horizontal, and each row of lamps projects its light onto the opposite side of the arch. A good deal of experimenting was done to get the proper angle for the reflectors, so that a uniform illumination of the arch might be obtained, as shown in the illustration.

The helmets rest in wooden cradles, the lamps being supplied through several feet of flexible cord from junction boxes opposite each reflector. For renewing lamps or cleaning the reflectors, the cover can be reached from overhead platforms running the length of the structural girders. The reflector lamps are switched in groups of four alternate units, so that any desired degree of illumination can be obtained. All of the interior lighting is controlled from a panel box at the rear of the altar.

The side panels of the ceiling are indirectly lighted by six chain-suspended, eye-comfort reflector bowls, three on each side, each bowl containing four 100-watt tungsten lamps. The outsides of the bowls are tinted an ivory color, with gold trimmings, harmonizing well with the predominating colors of the temple interior, ivory for the ceiling and a darker cream for the sidewalls. The benches are of Circassian walnut.

As the indirect lighting bowls are suspended 5 ft. from the ceiling and at a height of about 25 ft. above the benches, some means for reaching the lamps and reflectors without the use of ladders had to be provided. Accordingly, multiple-type arc-lamp hangers were resorted to, and the

Fig. 1—Interior View of the North Chicago Hebrew Temple.

entire fixtures, canopies and all, were suspended from windlasses, arranged so that the whole unit can be lowered to the floor. When hoisted to the ceiling the contact rings engage with the ceiling receptacles, completing the circuits to the lamps.

A little difficulty was encountered at the beginning in getting the fixture canopies to fit snugly against the ceiling, so as to hide the receptacles, since the arc-lamp hanger requires that the lower member be first pulled an inch above the permanent position and then dropped into place. This difficulty was solved by making the canopy of telescoping construction so that its upper rim is always pressed firmly against the ceiling by a spring.

In the photograph several small direct-lighting brackets will be noted on the side walls. These 8-cp lamps were installed as emergency units in compliance with the Chicago city ordinance which requires that for every 400 sq. ft. of floor area in a public hall there shall be a lamp on a separate circuit from the main lighting and controlled from a public passageway.

In the indirect lighting of the North Chicago temple a total of 7600 watts of tungsten lamps is used, illuminating an area of 6160 sq. ft. Although no photometric tests have yet been made, the intensity everywhere in the auditorium is sufficient to permit the smallest print to be read easily, even by the old people of the congregation. Special lamps originally planned for the use of the choir over the altar

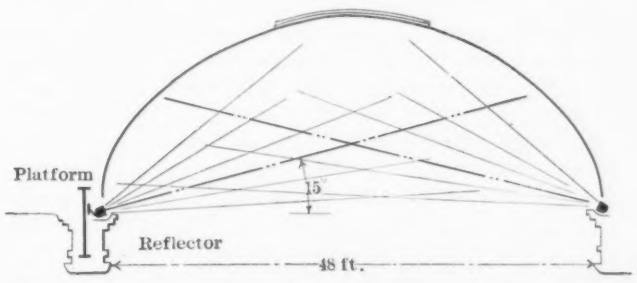


Fig. 2—Cross-Section of Main Arch, Showing Arrangement of Reflectors.

have not been installed, as the general indirect illumination was found sufficient for all purposes.

The lighting and electrical features which characterize the North Chicago Hebrew temple were laid out by Mr. M. C. Hartman.

INTERIOR CONDUIT SYSTEMS FOR FEDERAL BUILDINGS.

By Nelson S. Thompson.

The standard arrangement of the electric-lighting installations in federal buildings under the control of the supervising architect, Treasury Department, consists of an underground service connection to an entrance switch just inside of the building. In small buildings where only two distributing cabinets are used the entrance switch and the subfeeder switches are concentrated in the same cabinet, and in the larger buildings requiring three and not more than four distribution cabinets there is installed a subfeeder tablet from which subfeeders or mains are run to the various distribution cabinets located throughout the building. Where more than four distribution cabinets are necessary the subfeeder cabinet and main switch cabinet are eliminated and a switchboard is installed. In the large buildings, in which an electrical generating plant may be installed at some future time, a standard type of switchboard is installed in the engine room with a service connection to the local companies' mains.

The main service switch is usually located as near as possible to the point at which the feeder circuit enters the building and the subfeeder tablet or the switchboard is so located as to obtain the best runs and the shortest average length, capacities considered, of subfeeders. The point sought for is one at which the sum of the products obtained by multiplying the length of each subfeeder by the number of its ampere capacity is a minimum. In selecting the location for main service switch and subfeeder tablet or switchboard due consideration is given the character of room in which it is to be located, and they are not located in coal-storage rooms, storage rooms, or in letter carriers' lounging or toilet rooms.

The distribution cabinets for the post-office section are in the post-office workroom, so that all lamps in the workroom, letter carriers' lounging and toilet rooms, and the executive offices of the post office, can be controlled from them. All other cabinets in the building are located in public spaces, such as corridors or lobbies, or in the basement outside of post-office space and storerooms. The locations sought for distribution cabinets are those which will admit of being readily reached with the feeder and which will make all branches of approximately equal length. The maximum length of a branch circuit is generally limited to 100 ft. The architectural features of the building are considered in locating distribution cabinets.

The public lobby on the first floor and the exterior lamps at the main entrance are controlled from a cabinet located in the lobby, or, in special cases, in the basement. In cases where not more than three circuits are required to supply a floor above or below a given cabinet they are controlled from the cabinet mentioned. As a general rule not more than sixteen circuits are taken from a cabinet and usually one or more spare switches are provided on each distributing cabinet.

In locating distribution cabinets in thin walls, care is taken to see that a steel beam is not located directly over the cabinet, and should this be the case the structural engineers are requested to substitute two channels for the beam and set the backs of the channels 1½ in. apart. A cabinet is never located in a partition wall less than 4 in. thick, exclusive of the plaster. The cabinets containing the distribution panels are of steel and both the cabinets and the tablets are of special design. The tablets are of marble and contain 25-amp switches and 10-amp inclosed fuses controlling the various circuits.

All wiring is run in rigid metal conduits and all main service connections to the building are made underground either from a steel pole located on federal property or from the service poles of the company adjacent to the

federal building site. The conduits to the service poles are run up a distance of 10 ft. and are provided with a weatherproof hood. The former practice of installing handhole boxes at the base of service poles has proved to be unsatisfactory, and has, except in special cases, been abandoned. The junction box on the main feeder conduit inside of the basement is not made less than 8 in. x 8 in. x 4 in. as a rule, and when the service switch is close to the point of entrance of the service conduit the junction box is sometimes omitted.

The feeder and other conduits in the basement larger than 1 in. are run exposed on the basement ceiling and are installed parallel to the lines of the building. As a general rule all other conduits in the building, except in the roof space and in unfinished attics, are concealed. Conduits in floors are run in the most direct manner and are not as a rule made larger than 1½ in. in diameter, as a larger size is difficult to conceal in the floor construction. Care is taken that conduits do not cross each other in the floor construction.

In the majority of cases the conduits run up from the cabinets and run in the floor construction above with drops to the single-pole snap switches at the entrance doors. This

CONDUIT SIZES FOR CONDUCTORS.

Wire and Cable Size.	Two Wires, Same Size. Inches.	Three Wires, Same Size. Inches.	Four Wires, Same Size. Inches.	Three Wires, Double Size, Neutral. Inches.	Duplex Wires. Inches.
14	½	¾	¾	¾	½
12	¾	¾	¾	¾	½
10	¾	1	1	1	¾
8	¾	1	1	1	
6	1	1¼	1¼	1¼	
5	1¼	1¼	1¼	1¼	
4	1¼	1¼	1½	1½	
3	1¼	1½	1½	1½	
2	1½	1½	2	2	
1	1½	2	2	2	
0	2	2	2	2½	
00	2	2	2½	2½	
000	2	2½	2½	2½	
0000	2½	2½	2½		
200000	2½	2½	2½		
250000	2½	2½	3		
300000	2½	3	3		

NOTES:—The above table is based on double-braided rubber-insulated wire and unlined metal conduit.

The conduit sizes are given for runs up to 100 ft. with not more than four right-angle bends between outlets. For longer runs larger conduits are used.

LEAD-INCASED CABLE IN UNLINED METALLIC CONDUIT.

Wire and Cable Size.	Two Wires, Same Size. Inches.	Three Wires, Same Size. Inches.	Four Wires, Same Size. Inches.	Three Wires, Double Size, Neutral. Inches.
8	1¼	1½	1½	1½
6	1½	2	2	2
5	2	2	2	2
4	2	2	2½	2½
3	2	2	2½	2½
2	2	2½	2½	2½
1	2	2½	3	3
0	2½	2½	3	3
00	2½	3	3	3
000	2½	3	3	3
0000	2½	3	3	....
25000	3	3	3½	....
300000	3	3½	3½	....

is, however, a matter which is governed by the construction, ceiling heights, etc., and an effort is made to reduce the length of the runs to a minimum. In vertical risers containing wires of the following sizes and lengths provision is made for supporting the wire by making a right-angle bend in the conduit or in a junction box: No. 0 wire, a support every 100 ft.; No. 00 to No. 0000, a support every 80 ft.; No. 0000 to 300,000, a support every 60 ft.

The preceding tables, many of which are due to Mr. N. R. Stansel, formerly an inspector of mechanical and electrical engineering in the supervising architect's office, are used to ascertain the size of conduits to accommodate the various sizes and number of wires.

OUTLETS.

The standard type of outlet boxes suitable for rigid conduits are used and no conduit larger than ¾ in. is connected to any outlet box and not more than four connections are made to any outlet box. The locations of outlets are made to conform to the architectural treatment and to the construction of the building. This requires generally the symmetrical spacing of outlets and the placing of the same so as to not interfere with construction details. Ceiling outlets are used for general illumination, and bracket outlets are used only where space restrictions demand them, that is, in small toilet rooms, stair landings, low ceilings, etc. Bracket outlets are also sometimes used for ornaments in court rooms. As a general rule ceiling outlets in the same space supply from 150 to 300 sq. ft. of floor area. Single outlets will often supply a smaller area than the minimum value given above.

In general the ratings of ceiling outlets do not exceed 300 watts, bracket outlets, 50 watts, and receptacles, 50 watts. Some bracket outlets at windows in post-office screens, in court rooms, in lobbies, on exterior of building, etc., will supply 100 (or more) watts. Court-room and lobby ceiling outlets, where the total number of outlets is restricted by the architectural treatment, have a greater rating than 300 watts. Such outlets sometimes require more than one circuit.

Rooms less than 20 ft. square have one ceiling outlet. Rooms over 20 ft. in either dimension, and narrow rooms, have two or more ceiling outlets placed on the longer dimensions, the number of rows of outlets being governed by the width of the room. In the post-office workroom a space about 3 ft. wide adjacent to the screen is considered to be sufficiently lighted by the brackets on the screen, and this area is deducted from the total area of the room in calculating the illumination.

In locating outlets in large office rooms the possibility of such rooms being subdivided at some future time receives consideration. The location of ceiling outlets in court rooms and in main lobbies depends very largely upon the designs of the ceilings and other architectural features of these spaces. As far as is practicable ceiling outlets are located in the centers of squares.

It is considered that approximate uniform illumination is obtained when the distance between the outlets is equal to twice the height of the lamps above the plane of illumination, using reflectors which direct the greatest portion of the light downward within an angle of 60 deg. from the vertical and with the maximum apparent candle-power at about 45 deg. from the vertical.

Outlets near beams are located a sufficient distance from the beam to admit of the placing of a standard 4-in. outlet box, and if the beam projects below the ceiling the outlet is located a minimum of 10 in. from the outer edge of beam flange. If a beam is directly over a necessary or very desirable location for an outlet, an effort is made to have structural engineers substitute two channels with a 1½-in. space between the same for the single beam. Outlets are not placed within 6 in. of heating mains or other large piping. A ceiling outlet is not located in front of an inward projecting revolving door unless the edge of the roof over the door is at least 3 ft. from the center line of the lobby.

Ceiling outlets are not placed on skylight frames unless necessary; if such is the case, special construction of the frames to accommodate the piping, gas and electric, outlets, boxes, canopies, etc., is obtained from the architects.

Combination ceiling outlets are not used where the ceiling heights are less than 8 ft. 6 in.

The standard height of bracket outlets is 7 ft. above the floor, but in court rooms the bracket outlets are frequently placed higher than 7 ft. above the floor. Bracket outlets are located so that the fixture canopy will rest on a smooth plane surface not less than 5½ in. wide. Bracket outlets are provided over each window in the post-office screen, unless two windows are quite close together, in which case one outlet will serve both windows. Bracket outlets are provided on the lock-box section also, on the basis of one outlet for each four feet to six feet of length of the box section.

To supply the local illumination of furniture in post-office workroom bracket outlet boxes with covers are set out fully exposed on the basement ceiling. One box is provided for each 300 sq. ft. of floor area, and each box is rated at 500 watts in calculation of wire sizes. Receptacle outlets for local illumination are placed in both floors and walls of the principal offices and in walls of all office rooms.

The floor outlets are located on the center line of the room, longer dimension, and one floor outlet is provided for each 250 sq. ft. of floor area when more than one such outlet is needed. Desks are generally placed so as to receive a maximum amount of daylight, and this guides the selection of the locations for wall outlets. One such outlet for each two windows of the average office is provided unless conditions indicate the need of a greater number. Money order and registry rooms have one or more wall outlets. An outlet is provided in each elevator and lift shaft and located at the center of travel of car.

A plug receptacle is provided at each end of the judge's bench and a plug receptacle is also provided for the clerk's desk. Bracket outlets, which are placed against the wall, are provided over the writing desks in the public lobby. Outlets on portable lobby desks are so connected that the tearing up of a floor to place the conduit will not be necessary, a junction box being set on the basement ceiling near the probable location of the riser to the desk bracket, and the horizontal run of conduit from the box to the desk riser is exposed on basement ceiling.

The ceiling outlets in the first-floor lobby are supplied by at least two circuits. The outlet for the elevator circuit is connected on a basement circuit which supplies outlets in the boiler room. The special junction boxes on the basement ceiling are connected two on a circuit, or in case there is an odd number three per circuit. The branch circuits are connected so that the loads on the two sides of the three-wire circuit will be approximately balanced. The outlets in public toilets and in attics are connected on the corridor circuits. In the workroom not more than two ceiling outlets are connected on one circuit. Independent circuits are provided for the post-office screen outlets.

Outlets in the lobby, outside entrance outlets, and basement outlets not in spaces connected with the post-office working space are connected to a tablet in the lobby or the basement. The outlets for the lobby desks are connected to either the workroom or lobby tablets.

In court rooms an independent circuit is provided for the outlets at the judge's and clerk's desks, and if conditions require two circuits are run to each ceiling outlet. Outside fixtures at each entrance are in general connected on a separate circuit, but where the fixtures are small those at the two entrances are connected on one circuit. Lead-covered rubber or paper-insulated wire is run from the junction boxes just inside the wall in the basement to the outdoor lamps at the main entrances. At each vault in the building a plug receptacle is provided on the exterior near the lock side of the door, and in cases where the vault exceeds 80 sq. ft. in floor area a ceiling outlet box is provided in the vault with a receptacle just inside the door so that the inner and outer receptacle may be connected with a flexible cord when desired.

Outlets are provided in the roof space or attic, as judgment dictates, and ample illumination is provided for the overhead sheaves of elevators. The outlets in the basement and machinery spaces are located as judgment dictates. Each branch circuit is controlled by a double-pole knife switch located on the distribution tablet.

Except in the post-office workroom and basement and unfinished attic or roof spaces all ceiling outlets and all bracket outlets located over 9 ft. above the floor are controlled by snap switches. Snap switches are of the single-pole, flush type, and are set 5 ft. above the floor, and those in public spaces have a lock attachment. Snap switches in rooms are located near the entrance-door casing on the lock side. Large rooms which have two entrance doors from the corridor and more than one ceiling outlet have a snap switch at each entrance door. Switches controlling large spaces and long corridors are frequently placed in gang boxes, but not more than three switches are placed in one gang box. Switches are not located in partition walls less than 4 in. thick, and are so placed that the face plate will rest on a smooth plane surface.

A uniform-size 10-amp fuse is used for all branch circuits; the smallest wire in lighting fixtures used is No. 16. The sizes of fuses for feeders and subfeeders are selected to correspond to the carrying capacity of the wires, which the fuses protect. In case of a small switch controlling a large cable the size of the fuse is adapted to give protection to the switch.

Letters to the Editor.

The Relation of Temperature to Stream Flow.

To the Editor of the Electrical World:

Sir:—In following your recent editorial comments on the relation of deforestation to stream flow, as brought forth by Professor Mead's *Bulletin,* I observe that no particular emphasis has been placed on the relation of temperature to floods. But this factor is undoubtedly one of the elements of the problem, although not perhaps of major importance.

Under average conditions the flood stage occurs during the spring of the year, but the exact time of occurrence, the intensity and the duration are uncertain. At this point the temperature plays its important part. An early thaw, lasting perhaps a week, will inevitably swell the streams, without regard to the immediate rainfall. If rains occur at the same time the effect is naturally accelerated and usually the flood touches a higher mark. On the opposite hand, a long, cold spring and a late thaw will defer the flood perhaps many weeks.

Of course, these remarks apply to a climate like that of our middle and northern belt, which includes Wisconsin. The spring temperatures, and also the winter temperatures, undoubtedly account to some extent for stream flow variations which are difficult to explain on the basis alone of rainfall. Perhaps we can go even farther with this and study the proportion of rainfall which is precipitated as snow. In the case of a thaw, it is reasonable to believe that melting snow would give up water at a faster rate than the earth's frozen crust, and hence the crust beneath the snow would be less affected by the temperature, and the water released would not reach the subsoil, but pass off largely on the surface, to the brooks and streams.

Following this still farther, it is evident that deforestation will cause the snow to melt much sooner than it otherwise would, as anyone knows who has been through the forests in the late spring, when the snow in the open has long since disappeared. The proportion of snowfall varies from year to year, as well as the total rainfall—another factor in this fascinating question.

When we come to consider all the probable or possible elements which determine stream flow it seems likely that

our recorded data have hitherto been hardly comprehensive enough to enable us to settle the question. Certainly it demands the most careful study and research.

Chicago, Ill. Frank F. Fowle.

Depreciation

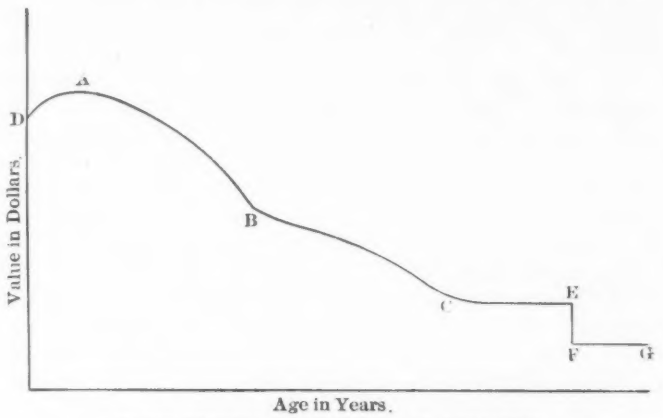
To the Editor of Electrical World:

Sir:—Your issue of Aug. 5 contains a very timely and interesting article on "Depreciation," by Mr. H. G. Nutting.

It is a pleasure to note that Mr. Nutting has adopted one of the suggestions of my recent paper on the subject of "Depreciation," presented at the convention of the American Institute of Electrical Engineers, and has published exact data on age and depreciation of physical property. He has very properly been careful to set forth the reasons for the abandonment of the property referred to at the ages indicated. It is worthy of comment that not in a single instance cited is any clew given as to the life of boilers or engines where depreciation is due merely to age—his example of "lack of capacity" being depreciation due to inadequacy or obsolescence. Another conclusion to be drawn from a study of Mr. Nutting's table supporting the observations by other engineers is that local conditions and individual treatment materially affect the life of apparatus.

In connection with depreciation on boilers it is worth noting that out of a collection of several hundred specific records owned by the writer there is not a single instance of water-tube boilers having been abandoned or retired because of age; and out of 152 fire-tube boilers, varying in life from nine to thirty-four years, it is found the average life was 20.7 years. The great variation in life is due to methods of firing, quality of water used and system of maintenance. It is said that the life of the Scotch type of boilers formerly used in the United States Navy averaged about seven years, this briefness of life being due to the use of more or less salt or brackish water and irregular conditions of operation.

Mr. Nutting gives an interesting curve showing his ideas of the rate of depreciation of apparatus, but he will probably find few engineers who are ready to accept his curve as the correct one. Very much apparatus does not increase in value shortly after installation, so that the point *A* would not apply; similarly, much apparatus is scrapped as soon as its regular use is discontinued and therefore has no section of curve *B C*. It can thus be safely concluded that no general curve will apply to each particular type of apparatus.



Curve Showing Depreciation of Apparatus.

Mr. Nutting is mistaken in his statement that "the practice of the Wisconsin Railroad Commission in making a valuation does not use the straight-line method, but rather 'a 4 per cent compound-interest depreciation curve'." The Wisconsin commission frequently uses the "straight-line method"—for example, in estimating the rate of depreciation of the electrical plant of the Madison Gas & Electric Company. He is correct in calling attention to the fact that the said commission modifies the amount of depreciation for given age according to the condition of the apparatus.

New York. Henry Floy.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Effect of Short-Circuit Armature Currents Under the Brushes in Interpole Motors.—E. Rosenberg.—In interpole direct-current motors hunting troubles may occur if the motor is working with a weak field, for instance, in motors for a wide range of speed which is obtained by shunt regulation. The author agrees with the explanation of R. Pohl that the hunting phenomenon is due to the short-circuits under the brushes. He first discusses the magnetic effect of the brush currents in machines without interpoles. It has a demagnetizing effect when the machine runs as a generator and strengthens the primary field when the machine runs as a motor, while the cross-magnetizing armature reaction is the same whether the machine runs as a generator or a motor. The magnetic influence of the short-circuit currents under the brushes can be very considerable, and is, to a large degree, dependent upon the speed, the reactance of the short-circuited coils, width of the brush and actual contact surface of the brush. In consequence of the last-named item, the mechanical condition of the commutator is of great importance, and hence it is possible that high mica, a high bar or a rough commutator surface influences the magnetic conditions of a machine to a considerable degree. The author then discusses interpole machines. A commutating pole of ideal proportions could produce an ideal commutation, namely, a reversal of the current in the no-load neutral. If the commutating pole is too weak the reversal of the current will be delayed, and therefore the action of the brush currents will be the same in quality, if not in quantity, as that of a machine without commutating poles. However, if the commutating pole is too strong the current reversal will take place before the no-load neutral is reached. In the case of a generator the main field will be strengthened; in the case of a motor the main field will be weakened by the brush currents due to a strong commutating pole. The first assertion explains the well-known fact that it is possible with proper brush position to obtain a level compound or overcompound characteristic in a shunt machine with commutating poles even when the brushes are fixed in the no-load neutral. Very often the compounding action is falsely attributed to the direct action of the commutating pole. This would offer an explanation, first of all, only for a brush position with a backward lead, for only in this case does the commutating pole, having the polarity of the main pole following it in the direction of rotation and being series-excited, support the main pole. Considering, however, that commutating poles are very often of such a small cross-section that the total flux going through them is only a few per cent of the main flux, and that a

compound characteristic can be obtained even with brushes in the no-load neutral, it is clear that the direct action of the commutating pole is not a sufficient explanation, whereas the action of the brush current ampere-turns working on the big magnetic mass of the main field coil explains the phenomenon fully. With regard to motors, the brush currents due to a commutating field which is too strong will weaken the main field. If the commutating pole was always too strong and the brushes were in the no-load neutral, then such a motor would behave like a compound-wound motor with reversed series winding. Now, it is easily possible that a commutating pole with a given number of turns is too strong with small currents and too weak with large currents; also, that it is too strong for low speeds and too weak for high speeds. The change in the relative value of the commutating field is particularly marked if the commutating pole has considerable leakage and has a small section. For lower currents below a critical current therefore the main motor field is weakened, for higher currents strengthened. Such an influence is very apt to set up hunting. In every motor, of course, slight oscillations of current occur all the time, because of the small oscillations in the impressed emf, due to small variations in the load torque, even if the motor is loaded with a practically constant load. In an interpole motor, if the current is for a moment smaller than it ought to be, the commutating field will be too strong and the brush currents will weaken the main field, thus causing the motor to speed up. With the reduced field the motor will take considerably more current, and the current may be so high that the commutating pole will then be too weak, which, in consequence of the brush currents, will strengthen the main field and will make the speed come down a very considerable amount when the action starts fresh again. There are several remedies for the hunting of interpole motors. One well-known way is to increase the air-gap in the main field. Another means is to set the brushes forward in the direction of rotation. This means, however, is only applicable in non-reversible motors; the forward brush position for one direction would turn out a backward position for the other direction and aggravate the evil. For reversing the motors the brushes have to be kept in the no-load neutral, and then it is important to keep the ratio between interpole ampere-turns and armature ampere-turns as low as ever compatible with good commutation. For this purpose the air-gap between interpole and armature should be made small, the pole tip should be shaped so as to give very small leakage and the body of the interpole should have sufficient section to prevent saturation, and then it will be quite possible to commutate with a slight excess of interpole ampere-turns. —Lond. *Electrician*, Aug. 4.

Hysteresis Torque.—H. ZIPP.—The author refers to a recent discussion on the explanation of the sudden jump of power when an induction machine passes through synchronism from lower to higher speeds. This phenomenon has been used for separating the iron losses in an induction motor, but the question has been raised whether the hysteresis torque is independent of the slip or not. The author describes experiments with an eddy-current brake, with brake disks first of magnetic and then of non-magnetic material. They prove the existence of a hysteresis torque independent of the speed. At synchronism this torque may have any value between a positive and negative maximum according to the instantaneous position of the rotor in the field at synchronism.—*Elek. Zeit.*, July 6.

Ventilation of Machinery.—A note on a British patent of Siemens Brothers Dynamo Works, Ltd., and C. A. B. D. Koettgen (8392, July 27), an arrangement for ventilation of a generator of the turbo type, consisting of the combination of three fans on the rotor for forcing air through the stator air ducts, drawing air through the rotor air ducts and also through the air-gap. A partition within the generator separates the air discharged from the stator ducts from that discharged from the rotor ducts and the air-gap.—Lond. *Elec. Eng'ing*, Aug. 3.

Stray Fields of Transformers.—F. NIETHAMMER AND E. SIEGEL.—The authors discuss the leakage fields of regulating transformers in which more or less secondary coils can be disconnected, such as are in use on single-phase locomotives. The stray fields are discussed for different designs of these transformers.—*Elek. u. Masch.* (Vienna), May 21.

Circular Diagram.—C. F. GUILBERT.—The conclusion of his theoretical paper on the circular diagram of single-phase induction motors, giving a numerical example.—*La Lumière Elec.*, July 1.

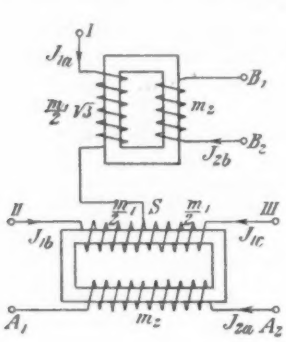
Lamps and Lighting.

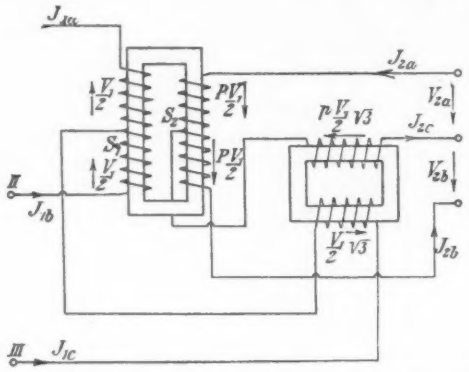
Photometric Flame Standards.—W. J. A. BUTTERFIELD, J. S. HALDANE AND A. P. TROTTER.—A paper presented to the International Photometric Commission at Zurich, giving a record of a research on the corrections for the effects of atmospheric conditions on photometric flame standards. The principal results may be summarized as follows: The curve connecting air pressure and correction factor is for the Harcourt lamp nearly a straight line for the range from 700 mm to 850 mm and shows that within these limits the light increases or decreases by 1 per cent, with an increase or decrease respectively in pressure of 12.5 mm; that is, that a variation of 10 mm in pressure is attended by a variation in the same sense of 0.8 per cent in the light afforded by the lamp. The curve of the Hefner lamp is likewise nearly a straight line for the range between 700 mm and 850 mm and shows that within these limits the light increases or decreases by 1 per cent with an increase or decrease respectively in pressure of 25 mm: that is, that a variation of 10 mm in pressure is attended by a variation in the same sense of 0.4 per cent in the light afforded by the lamp. Sets of observations on the Harcourt lamp showed that a change solely in the temperature of the air from 8 deg. C. to over 20 deg. C. had no definite effect on the light afforded, but the light of both the Harcourt and Hefner lamps decreases by 1 per cent for an increase of 0.16 per cent in the aqueous vapor in the air, so that an increase of 1 per cent in the aqueous vapor in the air is attended by a decrease of 6.25 per cent in the light of the lamps. It was also found that 1 per cent decrease in the light of the Harcourt lamp was caused when approximately 0.035 per cent of carbon dioxide was present in the air, and in the light of the Hefner lamp with 0.045 per cent present.—Lond. *Elec. Eng'ing*, Aug. 3.

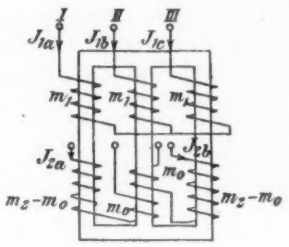
Generation, Transmission and Distribution.

Transformation from Two-Phase to Three-Phase.—G. RASCH.—A paper describing and comparing nine different methods for transforming three-phase currents to two-phase currents. The diagrams are given in Figs. 1 to 9. Fig. 1 shows the so-called Scott system. Fig. 2 shows the system of Meyer, which is very similar to that of Scott. Two single-phase transformers are used, the primary windings being arranged in the same way as in the Scott system. One free end of the secondary winding of transformer II is connected to the center of the secondary winding of transformer I. While in Figs. 1 and 2 two single-phase transformers are used, one three-phase transformer is employed in the method of Arnold, shown in Fig. 3. Standard star connection is used on the primary side. The secondary winding of each phase consists of two coils of $m_2 - m_0$ and m_0 turns respectively. But while the two coils of $m_2 - m_0$ turns are placed each on a separate core, the two coils of m_0 turns are placed together on the third core. In this case $m_0 = 0.52\ m_1 V_2 \div V_1$ and $m_2 = 1.93\ m_1 V_2 \div V_1$. In the next four arrangements auto-transformers are used. Fig. 4 shows the direct application of

the Scott system to auto-transformers. In Fig. 5 the two-phase circuits are connected to the terminals *IV*, *V* and *VI*. The circuits *II S* and *III S* are divided at the points *IV* and *V* respectively, in the ratio of $1-b \div b$, while the winding *I S* is divided at point *VI* in the ratio of $1-a \div a$ is applicable only as long as the ratio of the transformation of the voltages $V_2 \div V_1$ is not more than 0.866. But if the auto-transformer *I S* is replaced by a two-coil transformer, as shown in Fig. 8, the transformation ratio may be raised to unity. Moreover, in this case a three-wire







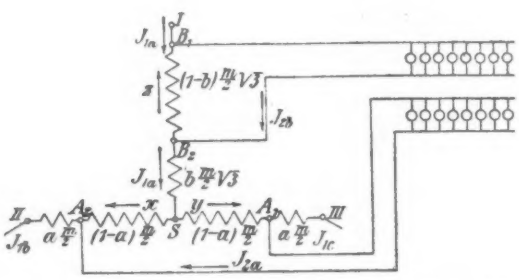
Figs. 1, 2 and 3—Diagrams Showing the Scott, Meyer and Arnold Systems of Transformation Respectively.

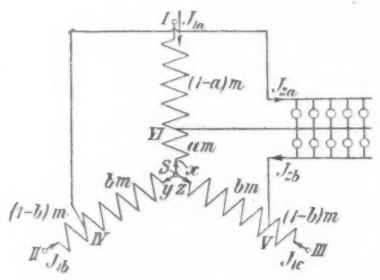
where $b = 1.414\ V_2 \div V_1$ and $a = 0.517\ V_2 \div V_1$. Another arrangement is shown in Fig. 6, in which $a = 1 - 0.816$

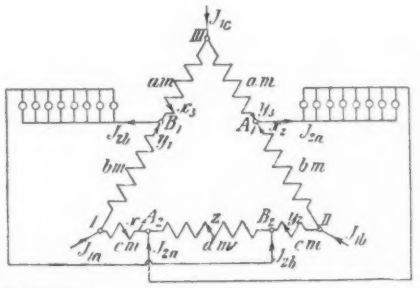
POWER IN KVA FOR $V_2 \div V_1$.

	0.1	0.3	0.5	0.7	0.8	0.85	0.9
Figure 1.....	96.5	96.3	96.3	96.3	96.3	96.3	96.3
" 2.....	87.5	87.5	87.5	87.5	87.5	87.5	87.5
" 3.....	97	97	97	97	97	97	97
" 4.....	108	141	200	325	451	503	.....
" 5.....	115	147	203	314	.....	.....	.....
" 6.....	84	118	120	185	262	333	.....
" 7.....	93	117	170	268	354	404	.....
" 8.....	101	113	127	140	146	149	151
" 9.....	235	263	295	295	295	295	295

$V_2 \div V_1$, $b = 0.816\ V_2 \div V_1$, $c = 1 - 1.115\ V_2 \div V_1$, $d = 2.23\ V_2 \div V_1 - 1$. A method of transforming three-phase into two-phase currents by two single-phase auto-trans-







Figs. 4, 5 and 6—Application of Above Systems to Auto-Transformers.

formers is shown in Fig. 7. In this case $a = 1 - 1.115\ V_2 \div V_1$, $b = 0.816\ V_2 \div V_1$, $c = 0.299\ V_2 \div V_1$. The last

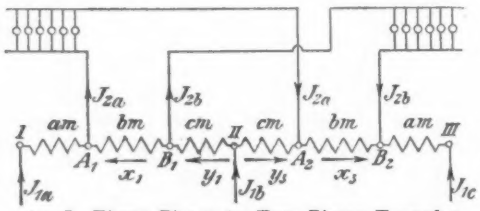


Fig. 7—Three-Phase to Two-Phase Transformation.

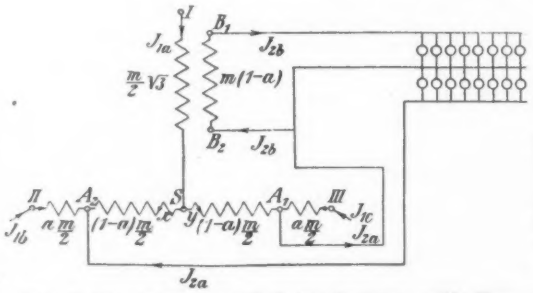


Fig. 8—Arrangement of Scott System with Two-Coil Transformer.

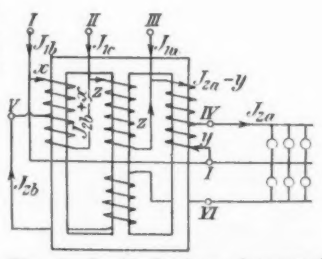


Fig. 9—Scott System Arranged for Low Transformation.

two arrangements use transformers which could be called neither normal transformers with two windings nor auto-transformers. In Fig. 4 the application of the Scott connection to auto-transformers was shown, but this method

system may be used on the secondary side, while in Fig. 4 four wires are required. Finally Fig. 9 shows a method of the Allgemeine Elektricitäts Gesellschaft. The principal equations are given for all the different systems, together with vector diagrams. In all cases the influence of an unbalanced secondary load on the primary system is the same. The primary currents differ less from each other in per cents than do the secondary currents. The utilization of the material is very different in the different methods, and aside from the first three cases it depends very much on the ratio of transformation. Designs which yield 100 kva at normal operation can be used for an apparent power given in the accompanying table.

For high ratios of transformation that arrangement of Fig. 4 appears therefore to be most valuable, while for low ratios of transformation Fig. 9 is the best; the latter also is preferable for values of $V_2 \div V_1$ between 0.866 and unity. —*Elek. Zeit.*, July 13 and 20.

Vibrating Wires and the Measurement of Distances.—C. A. Smith.—The propagation of transverse waves along a stretched wire is given by the formula $v = \sqrt{T/m}$, where v is the speed, T the tension applied and m the mass of unit length of the wire. On this the author bases a method for measuring distances which is accurate and

simple. It should have an application to the measurement of distances between poles or wire supports when the bases are inaccessible, especially where they pass over mountain gorges and over water or swamps. If a wire supported on both ends is struck or plucked near one end a transverse wave results which travels at a uniform speed to the distant end. On reaching the far end it is reflected and continues to traverse the wire to and fro several times, always maintaining the same velocity, but gradually falling in amplitude. If the exact time in seconds is known in which the pulse reaches the distant end, also the tension applied to the wire, and its weight per unit length, it is easy to calculate the length of the wire according to the above formula. The method is carried out as follows: An accurate dynamometer is attached to one end of the wire, which need not be cut, and with it the wire is drawn up to several tensions, which are noted. At each tension the wire is struck at a convenient distance from the draw-tongs attached and the exact time observed for the fifth return wave to reach the experimenter's hand held on the wire. This time interval is divided by ten to give the time taken for the wave to travel in one direction. A one-fifth-second watch is best suited for this purpose, and the mean of several readings should be taken at each tension and noted. If these readings are then plotted as ordinates, T and t, on squared paper, a curve of the shape given in Fig. 10 will be obtained if carefully drawn. Then if, say, three points a, b and c well spaced along the curve be taken, the correct distance in feet between the poles can be calculated from the following empirical formula by applying it to the three pairs of values thus found and then taking the mean of the results. $D = t \times (c \times T)^{0.503}$, where t is the time of outward wave; c is $30.5/w$, a constant; w is the weight of 1 ft. of the wire in pounds to four significant figures. Still more accurate results can be had if logarithms of the tension and time are plotted instead of the natural numbers. In this case there is obtained a straight-line curve. The factor of greatest importance, and the one which requires close attention, is the reading of time. As a converse measurement to distance by the same method, if the exact distance be known in feet, the tension of a given wire can be closely calculated, rendering a dynamometer unnecessary, by the following expression: T in pounds $= w \times (D/t)^{1.987} \div 30.5$. The author found that the tension thus determined agrees within 5 per cent always, with an average of 2 per cent above or below the actual values given by the dynamometer.—Lond. *Elec. Review,* July 28.

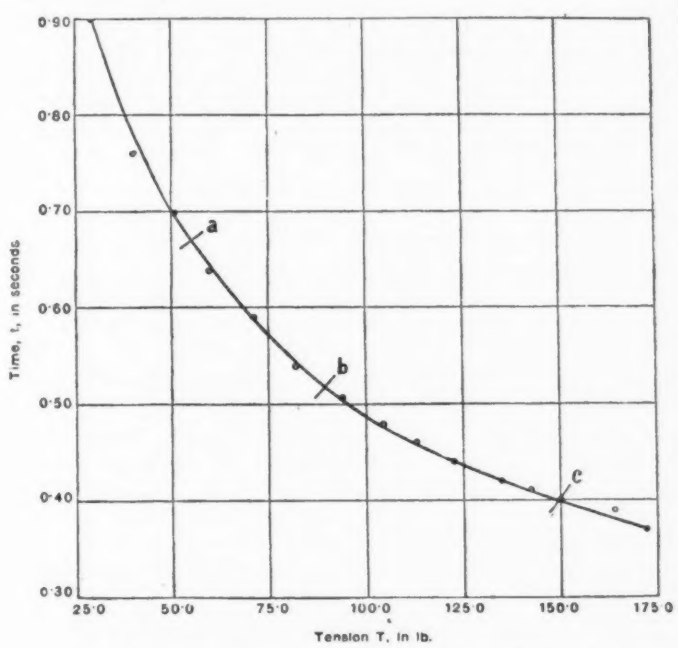


Fig. 10—Wave Curve for No. 14 Iron Wire.

Hydroelectric Plant.—A detailed description of the Gosau plant in Tyrol, which utilizes the falls of the Traun River. The falls are developed in five different steps. The first station contains two turbines each of 1500 hp, the second one one turbine of 800 hp, the third three turbines of 1500 hp each, the fourth one turbine of 1500 hp and the fifth four turbines of 2000 hp each and two turbines of 6000 hp each. One of the latter is used as reserve. The total rating will, therefore, be 23,800 hp. The four turbines of 2000 hp of the fifth station have been in operation since December, 1910, and the plant is working satisfactorily. Each turbine is coupled to a 1900-kva, 5250-volt, three-phase alternator. The transmission voltages are 25,000 and 43,500. The plant is working in parallel with the Traun plant at a distance of 36 miles (60 km). The farthest distance of the consumers from the Gosau plant is 67 miles (112 km).—*Elek. u. Masch.* (Vienna), July 2, 9 and 16.

Speed Regulation in Three-Phase Systems.—H. VON SÄÄF.—An illustrated paper read before the Electrical Society of Vienna on the different methods of speed regulation in three-phase systems and their application in mines and metallurgical works. The cascade connections of the induction motor and the three-phase commutator motor or rotary converter can be used for regulating large motors which revolve in one direction only. The Déri motor and the combination of two Déri motors to a double-commutator motor, which forms a uniform load on all three phases of a three-phase system, are used for reversing operations, especially in cases in which the brake effect is to be utilized and for smaller operations with a wide limit of speed regulation. For the latter purpose the three-phase series motor may also be used and it is also well applicable for reversing operations, especially those of small loads.—*Elek. u. Masch.* (Vienna), June 4 and 18.

Electricity in Mines.—An illustrated description of the electric equipment of the Sneyd Colony in Burslem, England. The installation is of interest because from very small beginnings it was gradually enlarged to an output of 1000 kw on account of satisfactory working.—Lond. *Electrician,* Aug. 4.

Steam Turbines.—H. ZOELLY.—A paper illustrated by diagrams presented at a recent meeting of the (British) Institution of Mechanical Engineers at Zurich. The author gives a historical account of the progress in theory and practice made in the design of the type of steam turbine that bears his name. He also shows how certain details must be modified in accordance with the work the turbine is likely to be called upon to do.—Lond. *Electrician,* Aug. 4.

Diesel Oil Engine.—F. SCHUBELER.—A paper read at the recent meeting of the (British) Institution of Mechanical Engineers in Zurich. The author gives a short survey of the practical development of the Diesel engine up to the present time and its application to various forms of driving.—Lond. *Electrician,* Aug. 4.

Traction.

Single-Phase Locomotive.—An illustrated description of the single-phase locomotive built by the Allgemeine Elektricitäts Gesellschaft for the Compagnie du Midi, of France. The two motors and the main transformer are arranged in the center of the locomotive. Two Winter-Eichberg motors are employed, each having an hourly rating of 800 hp. They have fourteen poles and are excited through the rotors. All brushes are conveniently accessible owing to the open form of construction adopted for the motors. The stators are wound with a single-phase lap winding. At high speeds the portion of this winding which lies in the reversing zone is connected to a part of the exciter transformer circuit by means of special contacts, in order to insure good commutation at these speeds. The stators are rigidly bolted to

strong cross girders. The rotors run in amply dimensioned bearings having pad lubrication. The bearings are not directly connected to the stators, but are bolted to the longitudinal girders on the lower frame. In order to allow convenient access to the commutators, no bearing shields are used. The frames are stiffened at the bearing by steel castings which are riveted to the locomotive framework. Within speed limits of 30 km to 55 km (18.6 miles to 34 miles) per hour energy can be returned to the line when traveling on down grades.—Lond. *Electrician,* Aug. 4.

Electric Traction in Switzerland.—E. Huber-Stockar.—A paper read at the recent meeting of the British Institution of Mechanical Engineers in Zurich. The author deals with the reasons why electric traction has not made as much progress in Switzerland as was expected because this was one of the earliest countries to adopt electric locomotion. He also gives full details of the various railways at present being electrically worked in Switzerland and finally of two schemes that have been prepared for the electrical operation of the St. Gotthard Railway. A list is given of the sixteen electrically operated railways in Switzerland, of which seven use direct current, six single-phase current and three three-phase current. The scheme for the St. Gotthard Railway proposes single-phase alternating current with a frequency of 15 cycles and a voltage of 15,000 for the supply to sections immediately adjacent, and of perhaps 45,000 volts for transmission to transformer substations delivering energy to the sections remote from the generating station. Two or three generating stations will be required. —Lond. *Electrician,* Aug. 4.

Installations, Systems and Appliances.

Electric Industry of Austria.—E. Honigmann.—The development of electrical industries in Germany as well as in Austria has taken place essentially in the ten years from 1900 to 1910. In 1900 there were in Germany 652 central stations with a total rating of 230,000 kw. In 1910 there were 2260 stations with a rating of 2,140,000 kw. The total number of plants now existing in Germany is estimated as 50,000 with an aggregate rating of 6,500,000 kw and a yearly production of 7,000,000,000 kw-hours. In Austria there were at the end of 1899 only 166 stations and in 1910 there were 675 with an aggregate rating of 295,000 kw. In the city of Vienna there were in 1900 three stations owned by companies with 1,102,000 connected lamps and producing 27,500,000 kw-hours. Now there is only one station owned by a company with 432,000 connected lamps and producing 8,400,000 kw-hours, and besides this the municipal central station, which supplies energy for lamps and motors (not including traction), produces 44,421,000 kw-hours, the connected lamps numbering 2,077,000. The receipts of the three privately owned companies in 1900 were $1,115,000, while the receipts of the municipal station in 1909 were $4,760,000. The receipts of the one station owned by a company were $780,000. In 1900 there were in Austria twenty-three electrical stock companies with a total capital of $29,000,000. At present there are fifty-one electrical stock companies with a total capital of $33,000,000, but this does not include the Vienna municipal central station and street railways, in which alone $48,000,000 is invested. In 1900 there were twenty-one electric tramways with a total track length of 68 miles (115 km). Now there are fifty electric tramways with a total length of 506 miles (843 km). Detailed tables are given of the imports and exports of electrical machinery into and from Austria.—*Elek. u. Masch.* (Vienna), June 25, July 2 and 16.

Domestic Uses of Electricity.—G. Dettman.—Continuations of his very long illustrated paper. The author endeavors to show that the prevailing idea that electric cooking is too expensive is all wrong. He emphasizes the cleanliness, simplicity and other advantages of electric cooking in great detail and then gives figures from his own experience, comparing the costs of cooking with gas and electricity. With a rate of 2.5 cents per kw-hour for energy for cooking and 10 cents for light, electric cooking is found to be cheaper than cooking with gas if the cubic meter costs 3 cents (1000 cu. ft., 84 cents). If the kw-hour for cooking costs 4 cents electric cooking is somewhat more expensive than gas cooking for the same cost of gas. Results of electric cooking experiments are given. The application of electricity for heating rooms (especially by electric heating rugs), for electric flatirons and curling irons is also dealt with. The paper is to be concluded.—*Elek. Zeit.,* July 13 and 20.

Electricity on Shipboard.—The conclusion of the illustrated article on the electric equipment of the steamships *Olympic* and *Titanic.* In the present instalment the use of electric power for operation of the winches and cranes of the accessory power gear and in connection with the ventilating and heating system is described. The system of electric clocks, telephones and the wireless telegraph equipment is also outlined.—Lond. *Electrician,* Aug. 4.

Ozonizers for Ventilating Houses.—J. B. C. Kershaw.—The article discusses the use of ozonizers for ventilating and similar purposes as a useful day load for central stations. A review is given of ozonizers made by different companies.—Lond. *Elec. Review,* Aug. 4.

Wires, Wiring and Conduits.

Fuses.—E. Jasse.—A continuation of his former paper on the theory of fuses. If the heat given off by the fuse is assumed to be constant and not to vary with the temperature, the theory shows that the time constant and the final temperature would become infinitely great for a certain critical current. The author now shows that if the correct assumption is made, that the heat given off by the fuse increases with the temperature, the theory gives finite values for time-constant and final temperature for any current. Finally, the effect of self induction on the time of fusing in short-circuit tests is investigated and it is found that the time of fusing is increased approximately by 1.5 times the electric time-constant.—*Elek. u Masch.* (Vienna), May 21.

Electrophysics and Magnetism.

Electric Resistance of Pure Metals at Very Low Temperatures.—H. Kamerlingh Onnes.—An account of experiments in which the author measured the temperature of pure metals, especially gold and mercury, at the temperature of liquid helium. The former conclusion that the resistance of pure gold vanishes at liquid helium temperatures is greatly strengthened. Extensive experiments were made with pure mercury. The value of the mercury resistance used was 172.7 ohms in the liquid condition at 0 deg. C. At 4.3 deg. C. on the Krypton thermometer this had decreased to 0.084 ohm and at 3 deg. C. on the Krypton thermometer it had fallen below 0.000003 ohm.—Lond. *Electrician,* Aug. 4.

Equalizing Currents.—C. Richter.—A long and highly mathematical paper in which the author gives some general fundamental formulas for equalizing currents (Ausgleichströme); that is, currents which equalize some existing difference in the conditions.—*Elek. u Masch* (Vienna). June 18 and 25.

Ions in Gases.—J. S. Townsend.—A paper criticising the conclusion reached in a recent paper of R. A. Millikan and H. Fletcher that no ions with double charges are produced in a gas of primary or secondary Röntgen rays. The present author thinks that the experimental evidence is in general entirely in favor of supposing that such double charges exist.—*Phil. Mag.,* July.

Electrostatic Lines of Force.—D. N. Mallik.—A mathematical paper describing a new and simple geometrical method of drawing the lines of force due to given static charges.—*Phil. Mag.,* July.

Units, Measurements and Instruments.

Measuring and Control Instruments.—D. Bercovitz.—A

paper read before the Vienna Electrical Society on various new measuring and control instruments made by the Paul Meyer Company. An instrument for inspecting lightning-rod installations is first discussed. It is used for measuring the resistance between the lightning rod and the earth. A

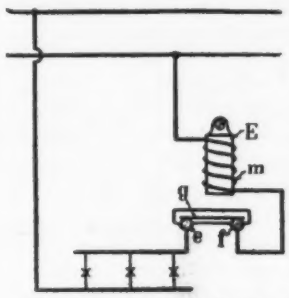


Fig. 11—Simplest Kind of Limiting Device for Lighting Installation.

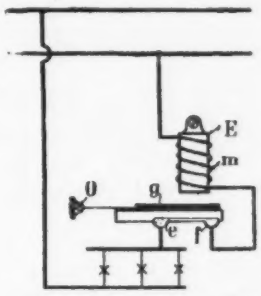
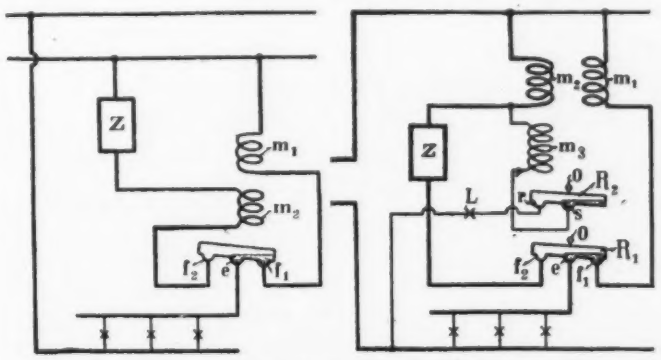


Fig. 12—Limiting Device for Currents of from 3 Amp to 12 Amp.

modification of this instrument for more universal use for measuring resistances, voltages, currents and for making insulation tests is also described. Quite a number of instruments are then described for use in lighting installations in which a flat rate is used and the consumer is to be restricted in the amount of power. The simplest limiting device is shown in Fig. 11. The coil m of an electromagnet E is in series with an iron rod g and the lighting installation. The iron rod g is contained in an air-tight tube and rests on two mercury cups e and f. When the current rises beyond the maximum value which the consumer is allowed to take the iron rod g is attracted by the electromagnet and the current connection between the two mercury cups is broken. Then the iron rod falls back and the current is closed again and so on. The lamps will flicker until the demand is decreased below the maximum limit agreed upon. In this form the controlling device is built up to 3 amp. For currents from 3 amp to 12 amp use is made of the modification shown in Fig. 12, in which the iron g is mounted on the outside of the closed tube. Within the tube there is some mercury connecting the two cups e and f. When the current rises above the predetermined value the iron rod g is attracted by E and the tube containing the mercury together with the iron rod rotates round the pivot O. The column of mercury which connects e and f is then broken. To prevent oxidation of the mercury the tube is filled with an inert gas. The power consumption of these devices is about 0.1 per cent of the power agreed upon, hence much less than that of meters. The application of similar limiting devices in connection with meters is also discussed. Fig. 13 shows an arrangement by which a consumer is charged a flat rate as long as his consumption is



Figs. 13 and 14—Instruments for Flat-Rate Change Below a Certain Consumption.

below a certain value. If he consumes more, the energy consumption is metered. The winding m is designed according to the maximum power which he can take at the flat rate. The current passes simply through m, through the mercury between the two cups e and f in the tube, and then through the lamps. If he demands more current the tube f_2, e, f is attracted upward and the mercury flows over and makes connection between f_2 and e. The meter Z is now in circuit. The coil m_3 keeps the tube attracted upward as long as the consumption is higher than the predetermined value. If then the demand goes below this limit the tube drops back into its initial position and the meter Z is disconnected. The exact design of the windings is somewhat difficult with this arrangement and the arrangement of Fig. 14 is preferable. In this case there are two tubes and they revolve around their centers so that no force is required to keep them either to the right or to the left. The winding m is again dimensioned according to the limiting value of power agreed upon. If more power is consumed m attracts the armature, the tube P turns over and connects the meter Z and the second winding m_2 in the circuit. Together with the winding m_2 there is a second winding m_3 on the same electromagnet core, but the direction of the mmf of m_3 is opposite to that of m_2. By means of the tube R_2, also connected with the armature, the voltage coil m_3 is connected to the circuit automatically when the meter Z is switched in. It is so dimensioned that its magnetic pull compensates that of the main current coil m_2 at the power consumption agreed upon and accomplishes the turning back of the armature when the demand goes below the predetermined value. The small lamp L is lighted when the meter is in circuit so that the consumer can always ascertain this fact. Some other modifications are also described, as well as some recording devices of the same company.—*Elek. u. Masch.* (Vienna), July 9.

Induction Meters at Varying Load.—KARL SCHMIEDEL.—An account of an investigation carried out in the German Reichsanstalt. Orlich and Schulze have formerly shown that the readings of motor meters and pendulum meters do not vary with varying load if, other than friction, there are no influences which would cause a deviation of the readings from the actual power consumption. This supposition is not fulfilled for induction meters on account of the damping effect of the alternating magnetic fluxes in the current and voltage circuits. The induction meter is therefore made the subject of the present investigation. The author shows that on account of the damping effect mentioned the readings of induction meters are too high at varying load. Under normal conditions, however, the error due to a certain change of load will be less than the difference of the errors for half-load and full-load when operation is without sudden changes of load. Only in exceptional cases may the error become large in practice, especially if the meter armature has a very high momentum of inertia, if the damping effect mentioned is very large compared with the torque, if the torque is very small and if there are short and strong variations of current or voltage (lasting less than one second).—*Elek. u. Masch.* (Vienna), July 2.

Miscellaneous.

Manufacturing Plant.—A very full and profusely illustrated description of the equipment and the different lines of manufacture of the Oerlikon Engineering Works in Zurich.—Lond. *Eng'ing*, Aug. 4.

BOOK REVIEWS.

THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN DER SYNCHRONEN EINPHASEN-MASCHINE. By Dr. Max Wengner. Munich and Berlin: R. Oldenbourg. 88 pages, 44 illus. Price, 2.40 marks.

A carefully planned, executed and reported research on a single-phase alternator with a view to determine the reaction of the armature on its own and on the excitation field. The research has led to the development of certain formulas which will be of especial interest to the designing engineer.

Qualitative Chemical Analysis, from the Standpoint of Solubility, Ionization and Mass Action. By J. I. D. Hinds. Easton, Pa.: Chemical Publishing Company. 265 pages. Price, $2.

A joint textbook and analysts' reference book. It is divided into five sections: I. Principles and Methods of Qualitative Analysis. II. Basic Analysis. III. Acidic Analysis. IV. Complete Analysis of an Unknown. V. Reagents and Tables. Great care has been taken in the preparation of the book and a large amount of material is collected into it. Special attention is devoted to the theory of electrolytic dissociation and the laws of mass action. To a certain extent, unconsciously, perhaps, the author has expounded very fully certain recent aspects of the electrical ionization theory. The work will be useful to analysts and to students of chemistry.

Encyclopédie Électrotechnique. F. Loppé, editor. Vol. V. (Induction and Alternating Currents.) By Eug. Vigneron. Paris: L. Geisler. 147 pages, 89 illus.

A treatise, from the mathematical standpoint, on the laws of electromagnetic induction and of alternating currents. The theory is particularly discussed on the analytical side, but the vector representation of alternating-current phenomena is also discussed. The book is valuable as entering more deeply into the fundamental theory of alternating currents than the ordinary engineering textbook. On the other hand, however, it is thereby the less to be regarded as an engineering handbook. The volume has an important place in an encyclopedia of electrotechnics.

Messungen an Maschinen und Motoren für Gleichstrom. By Fritz Hoppe. Leipzig: J. A. Barth. 171 pages, 214 illus. Price, 5.80 marks.

Commencing with the elementary principles of direct-current armature windings, the book deals with the various measurements and tests that are commonly applied to direct-current machines of the shunt, series and compound-wound type. The method employed is descriptive and geometrical with numerous arithmetical examples. The treatment is simple and clear. Numerous curves and diagrams accompany the text. The book will be of interest to elementary students of dynamo testing who desire to acquaint themselves with modern German practice.

Messungen der Stromstärke, Spannung, Leistung und Arbeit bei Gleich und Wechselstrom. Eichung und Graduieren von Messinstrumenten. By Fritz Hoppe. Leipzig: J. A. Barth. 134 pages, 128 illus. Price, 4.40 marks.

The book is divided into three sections, dealing respectively with direct-current measurements, alternating-current measurements and instrument testing. The book is elementary in character, but very clearly written, with numerous arithmetical illustrations. A number of instruments employed in electrical engineering are described in principle. In the last section various methods of adjusting and calibrating ammeters, voltmeters and wattmeters are described. The book will be appreciated by elementary students of electrical engineering interested in German methods and apparatus.

Beanspruchung und Durchhang von Freileitungen. By Robert Weil. Berlin: Julius Springer. 107 pages, 42 illus., 3 plates. Price, 4 marks.

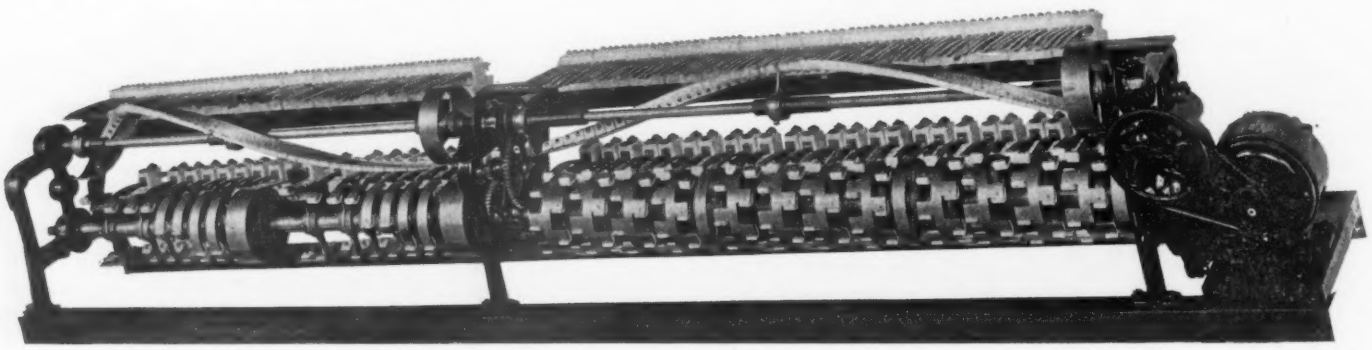
An engineering treatise on the tension in overhead wires of copper, bronze, aluminum, iron and steel for different spans, sags and temperatures, with tables and curves for the guidance of the constructing engineer. The book is thoroughly practical and well illustrated. The spans are not carried further than 1000 ft. at most in the tables and curves, so that specially long spans would have to be computed from the formulas. The constructing and designing engineers of long overhead lines for lighting and transmission will find the book of much value.

New Apparatus and Appliances

DOUBLE-DECKED SIGN FLASHER.

The flasher illustrated herewith has been built to operate a sign containing 1800 5-watt tungsten lamps. It contains 106 script switches, which are shown on the top layer, twelve high-speed switches, shown in the lower section at the end near the motor, and six 30-amp double-pole switches, shown in the lower section at the opposite end, together with double-pole controlling switches. The flasher mechanism runs in ball bearings throughout and is driven by a 1/30-hp General Electric motor.

The three sections revolve at different speeds, this result being accomplished by means of intermediate brass gearing. Although arranged in double deck to minimize the length, the height is only 12 in., which is said to be no greater than the height of ordinary single-deck flasher mechanism. The length is 65 in.



Double-Decked Sign Flasher.

Each contact is equipped with a non-arcing device and the brush is mounted in a porcelain holder. The non-arcing device consists of a porcelain insulating block which rotates with the contacting cylinders and lifts each brush from the cylinder until the position is such as to give full

contact area, when the brush is dropped suddenly into total contact, thereby avoiding the fusing which takes place when the contact area is too small. It is claimed that this so-called "Noark pickup block" permits the brushes to operate so as to insure long life and the minimum degree of friction.

In the high-speed section two switches are used for each contact; this arrangement is employed in order to permit the contacts to be used alternately and thus minimize the temperature at the contacts, which might otherwise become high on account of the unusually high speed of operation.

The above-described flasher was built by Betts & Betts, 302 West Fifty-third Street, New York.

DIRECT-READING OHMMETER.

The instrument shown in the accompanying illustration is for the rapid and direct measurement of resistances which fall within the range of the slide wire or the Wheatstone bridge to a commercial degree of accuracy, and is designed to fulfil the requirements of manufacturers, electricians, testing engineers and those who require an instrument giving results without calculation. The manipulation consists of closing the battery and galvanometer keys and rotating the index until the galvanometer indicates a balance. The unknown resistance is then read from the scale without the necessity of referring to a table of values.

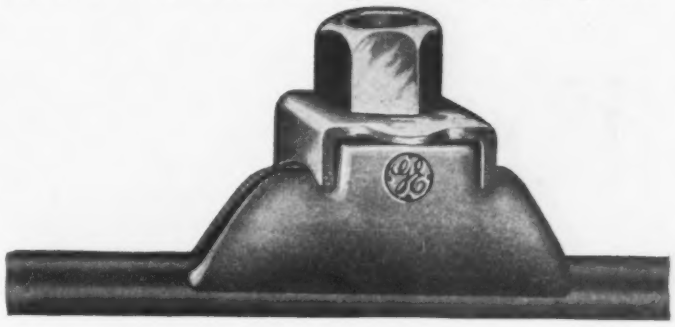
In order to give maximum accuracy multipliers are provided so that a balance can be obtained in the mid part of the scales for all resistances ordinarily measured in actual practice. A contained battery adapts it for portable purposes, as well as for bench use in manufacturing establishments and repair shops. The portable feature makes this instrument applicable for use in car barns for checking resistances in the car circuits, etc. Provision is also made for connecting an external battery to the instrument in cases where this is desirable.

The scale is engine-divided on brass and is, therefore, not subject to the defacement of paper scales. The convenience of manipulation is very striking, since it is only necessary to rotate the index to balance. This feature adapts it for use by those not skilled in the use of the Wheatstone bridge. The galvanometer in the ohmmeter is a sensitive D'Arsonval type as used in the high-grade portable testing sets manufactured by Queen & Company, Inc., Philadelphia, Pa., by which firm this new ohmmeter is also manufactured.

Direct-Reading Ohmmeter.

TROLLEY EAR.

The General Electric Company has recently placed on the market a new mechanical clamping ear, known as "Form M," especially designed for use on overhead construction in and around mining and industrial properties.



Mechanical Clamping Ear for Trolley Wires.

The ear consists entirely of forgings and punchings of steel, thus eliminating entirely such imperfections and variations as are common to iron castings. This feature also permits of using small light sections of great mechanical strength, resulting in an ear giving a maximum clearance from passing trolley wheels and a minimum height from the center of the wire to the top of the clamping nut. The jaws are duplicate drop forgings, each lip fitting into the recesses of the trolley wire with absolute accuracy, insuring a grip which will have the greatest possible holding power. The jaws are hinged by a steel pin located close to the wire and are of a length sufficient to utilize the maximum clamping effect produced by the clamping nut. The machine steel stud jacket engages shoulders on the clamps and fits into the hexagonal interior of the clamping nut; thus by rotating the nut the stud jacket is drawn on to the suspension stud while the nut exerts an outward pressure on the upper outer edge of the jaws, which by reason of the hinge press against the trolley wire.

The punched washer is formed around the top of the jaws to prevent its turning while the clamping nut is being tightened. It is also provided with two small lugs which may be bent up against the side of the clamping nut effectually preventing any possibility of the ear becoming loosened in service.

The new ear is made up suitable for round, grooved and figure 8 wire and has either japanned or standard sherardized finish. When used in connection with a suspension of the mining and ceiling type it renders possible an increase in head room of 1 in. to 2½ in.

14,000-KVA TRANSFORMERS.

The largest transformers thus far constructed have recently been shipped by the General Electric Company to the Shawinigan Power Company, at Shawinigan Falls, Canada. This shipment included four three-phase water-cooled units designed for operation at a frequency of 60 cycles, two of them having a normal load capacity of 14,000 kva and the remaining two of 12,500 kva. The 14,000-kva transformers will step the potential up from 6600 volts to approximately 100,000 volts for long-distance transmission. All four transformers have the same overall dimensions, occupying approximately 23 ft. x 8½ ft. floor space and being 18 ft. from the floor to the top of the high-tension terminals. The walls of the tank are made of steel plate ⅜ in. thick. On account of the great weights necessarily dealt with the supporting framework of the coils and core is built up of heavy "I" beams, the general apearance of the frames closely resembling the construction used in large locomotive framework.

These transformers were designed to withstand a test

of 270,000 volts from the high-tension winding to all other parts. Oil-filled entrance leads are employed and these also were subjected to this high-tension test. Although the striking distance of this test voltage in clear air is nearly

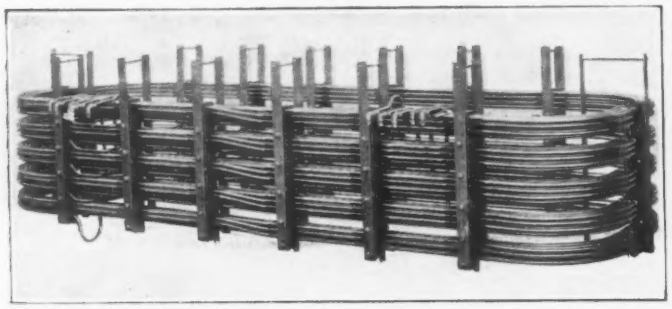


Fig. 1—Cooling Coils for 14,000-kva Transformer.

2½ ft., it is noteworthy that, when applied to these transformers after dark and with all lights turned out, no corona was visible.

There appears to be no practical limit in the design of

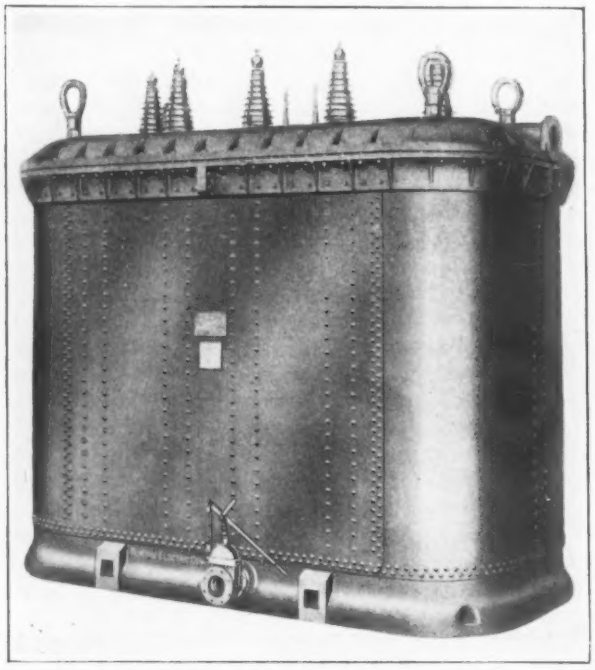


Fig. 2—14,000-kva Transformer.

transmission transformers from the standpoint of either capacity or voltage, as both of these conditions are limited by other features—the transmission lines being the limit for potential and the transportation facilities for the size of the units.

MEASURING NATURAL GAS WITH ELECTRICITY.

The People's Natural Gas Company, which supplies fuel gas for domestic and commercial consumption in Pittsburgh, has a pumping station near the town of Brave, in Greene County, Pa., 50 miles southwest of the city. In the suction line of this station there has been installed one of the Thomas electrically operated gas meters, which were described on page 573 of the *Electrical World* of March 2. As therein outlined, this meter, which is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., utilizes the principle of heating the gas traversing it through a fixed small temperature range, usually about 2 deg. Fahr.

The difference in the temperature is controlled and held constant by electric resistance-thermometer screens placed before and behind the heating element, and the electrical energy required to heat the gas is therefore proportional to the mass of gas flowing, regardless of its tem-

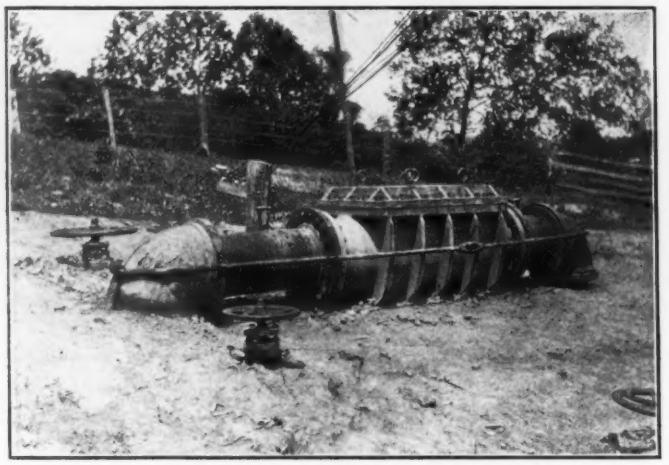


Fig. 1—Measuring Element in Pipe Line.

perature, pressure or volume. The energy input into the heater disk may be registered on a watt-hour meter or curve-drawing wattmeter, which can be calibrated directly in cubic feet of gas at standard conditions of temperature and pressure. About 1 kw-hour is required for each 75,000 cu. ft. of gas passing through the meter.

The Thomas meter at the Brave pumping station is installed in a field, about 200 ft. from the pumps. The casing inclosing the heating element and two thermometer grids is arranged between two elbows, as shown in Fig. 1, while the recording panel, shown in Fig. 2, is located near the switchboard of the station-lighting plant, from which energy to operate the meter is obtained. The meter is inserted in a 10-in. pipe, and has a maximum capacity of 750,000 cu. ft. of free gas per hour, but will register accurately quantities as low as 12,500 cu. ft. per hour. The accompanying curve in Fig. 3 is a portion of a daily record made by the curve-drawing meter element in the office of the pumping station, and shows fluctuations in the rate of flow of the gas caused by changes in the settings of valves or pumps. As already explained, this record is actually the curve showing the watts input into the heater, but since for any constant quality of gas a definite number of watt-hours is required to heat a given quantity of it

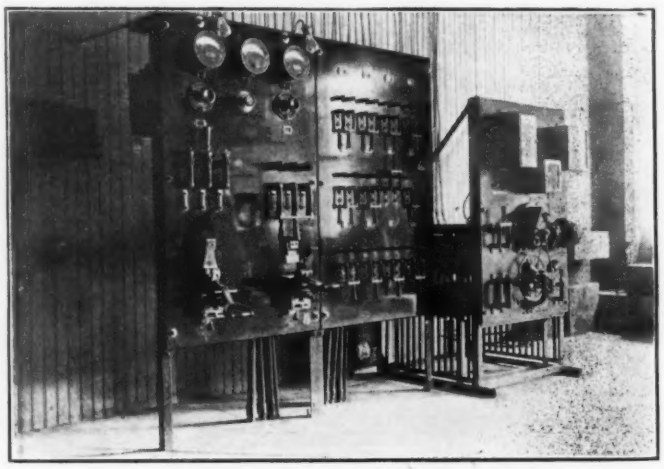


Fig. 2—Switchboard in Station and Gas-Meter Recording Panel at Right.

2 deg. Fahr., the curve virtually reproduces the rate of gas flow.

In connection with the electrical meter it is especially interesting to note that the record is made in terms of the

equivalent number of cubic feet at standard conditions of temperature and pressure. In the case of the Brave meter these are set at 15.025 lb. absolute pressure and 60 deg. Fahr., although the actual pressure on the gas line varies from 50 to 200-lb. gage, and the temperature of the exposed

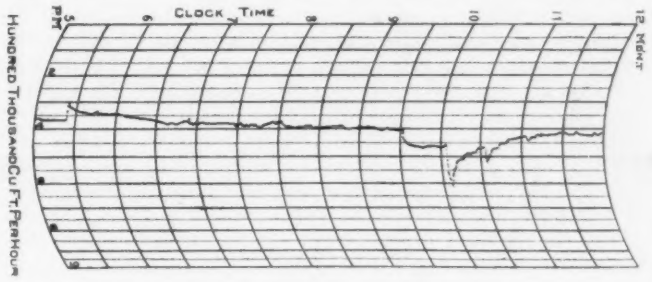


Fig. 3—Meter Record Chart.

pipe line and meter varies as widely as the outdoor temperature. Natural gas is used as fuel in the lighting plant of the People's company, and the electrical energy required by the meter, expressed in total cubic feet of gas measured, represents a consumption of about one-twentieth of 1 per cent of the gas measured.

Some recent tests made on the Thomas meter at the Brave station have shown the close accuracy of this device, even when no calibration has been made after setting the instrument in place. At Beulah, W. Va., 1½ miles distant from Brave, the People's company had already installed an accurately calibrated Pitot-tube station which can be inserted in series with the 10-in. line to the Thomas meter, and a 22-hour comparison test between the curve-drawing and integrating meters of the electric device and the Pitot tube.

While the rate of gas flow was kept nearly constant and the temperature remained about the same, the pressure varied from 123 lb. to 72 lb. per square inch. Other tests carried out on the Brave installation, including twenty-four-hour and forty-five-day tests under widely varying conditions of flow, pressure and temperature, have demonstrated such close agreement between the electrically operated meter and the Pitot tube that a natural quandary arises as to which is correct. During a forty-five-day endurance test, run from April 17 to June 3, the Pitot tube registered 337,546,182 and the Thomas meter 336,732,018, showing a difference of but one-fifth of 1 per cent after the most careful and frequent observations on the Pitot tubes at 15-min. intervals.

AUTOMATICALLY CONTROLLED ELECTRIC COOKSTOVE.

The convenience and simplicity of electric cooking on a domestic scale may be expected to be greatly enhanced through the automatic control appliances with which the new Copeman electric stove is equipped. This cooker employs the fireless principle of operation, the heating elements being inclosed in thermally insulated compartments, and through thermostatic cutouts being automatically cut off after the ovens have reached the predetermined temperatures for the cooking operations required.

The stove, as shown in the illustration, comprises two separate, well-insulated cooker ovens, one measuring 10 in. x 10 in. x 14 in., used for boiling, and the other, 19 in. x 12½ in. x 14 in., for baking and roasting. Each oven is fitted with a dial-type thermometer, the pointer of which upon making contact with an adjustable hand momentarily closes an auxiliary circuit, tripping out the heater switch. The temperature at which the heating element is thus disconnected can be set at any desired point by means of the thumb-controlled contact pointer. For the boiler the disconnect point is ordinarily set at 212 deg. Fahr. and for the roasting oven at 375 deg. After the temperature required to operate the cut-out has been reached, cooking proceeds with the heat already stored in the oven, which is so insulated as to lose only about 10 deg. in temperature per hour.

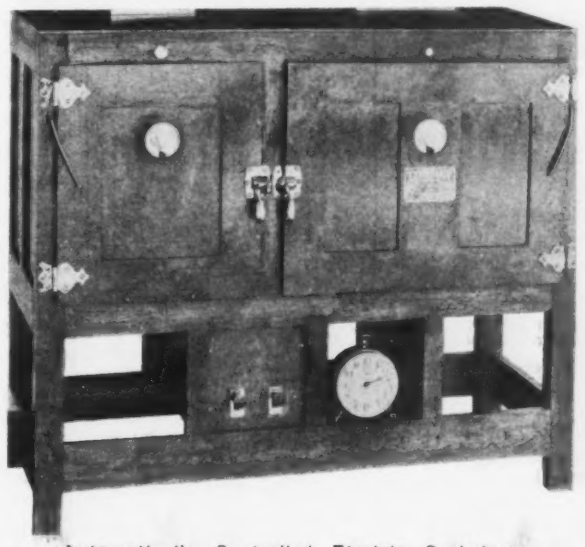
Where the housewife plans to be absent part of the day she may set the alarm-clock shown at the hour she wishes the oven to begin heating. When the alarm operates, a lever on the winding key throws a switch closing the circuit to the heating elements that have been turned on. Later, when the predetermined temperatures are reached in the ovens, the thermostatic circuit-breaker trips interrupt the heater circuits, cooking continues with the stored heat until the food is done and the housewife returns to find her dinner warm and waiting.

The switch handles for closing the heater circuits are shown at the left of the clock. Above the doors are two push buttons, connected across the respective thermostats, so that the circuit-breakers can be released by hand if it is desired to shut off the heaters before the thermostats operate.

Each cooking compartment contains a 660-watt disk heater, that in the boiler measuring 8 in. in diameter and the roasting element 10 in. in diameter. The terminals of the heater disk are brought out as contact tongues, which are inserted into push receptacles in the floor of the compartments. Similar receptacles are provided on the top of the cabinet, so that while cooking is going on in the oven with stored heat the disk elements may be removed to the top and used to heat a chafing dish, pan or other utensil, all of which are arranged to lock onto the disks. Where a chafing dish or percolator is to be brought to the table the heater element, still locked to the utensil, is disconnected from its receptacle and the whole brought onto the table, the heat stored in the hot disk element serving to keep the contents of the dish warmer than by its own thermal storage alone.

The cooker is built of specially treated wood, which is filled and stained to render it proof against action of heat, moisture, steam, acid and grease. The ovens are lined with bright copper, behind which is a ⅛-in. sheet of asbestos, 2½ in. of mineral wool and a second layer of asbestos against the wood.

A point claimed for the Copeman cooker, besides its convenience, is the low kw-hours consumption required in its operation. At the Electric Shop, Chicago, Aug. 16, a



Automatically Controlled Electric Cookstove.

dinner comprising four chickens, with dressing, steak, vegetables, biscuit, tea and pie was cooked for fifteen persons at an expenditure of 2600 watt-hours.

The stove described is built by the Copeman Electric Stove Company, of Flint, Mich.

Industrial and Commercial News

The Week in Trade.

FURTHER expansion in the volume of new business and growth of public confidence have developed in the past week, and business in nearly all lines is progressing on an encouraging scale. The cessation of tariff agitation and of further investigations as a result of the adjournment of Congress last Tuesday will have a beneficial effect upon general trade, and it is expected that the situation will be greatly bettered in the interval before the next session.

Retail trade is showing the effects of gradual advancement, and in wholesale lines the forward movement is more pronounced. Buyers are appearing in larger numbers than earlier in the season, and sentiment is improved in spite of the tendency toward conservatism. Gains are shown in the operations at the iron and steel centers, and there has been decided increase in the shipments of pig iron. Much of this activity is due to the large number of foundry orders of moderate sizes for early delivery, and sales of large tonnages are few, but the outlook is bright, and preparations are being made for blowing in many furnaces. Demand for steel products for both domestic and foreign interests is a most encouraging feature of the situation. Orders for railroad equipment are coming in more rapidly and negotiations are reported in progress for over 15,000 cars of various types. Some expansion has taken place in the New England woolen market, induced by the outcome of tariff revision; but the cotton market in that district has been checked somewhat by price conditions. Commercial centers show marked increase in weekly bank clearings, and crops are promising. Business failures for the week ended Aug. 17, as reported by *Bradstreet's*, were 215, as compared with 208 for the previous week, 222 for the corresponding week in 1910, 183 in 1909, 236 in 1908, and 153 in 1907.

The Copper Market.

THERE was little business in the copper market in the past week, and price changes were unimportant. While the larger producers asked 12⅝ cents for electrolytic delivered thirty days, a few small sales were reported at lower rates, but neither consuming or producing interests showed a strong disposition to enter into new contracts for large amounts under prevailing conditions.

Some price concessions were made abroad, but response was decidedly mild, the lack of interest being attributed to labor disturbances in Great Britain, and the probability that European consumers are well supplied for the next few months as a result of their recent purchasing at the low level of the market. The continuation of dullness following the favorable report of the Copper Producers' Association is thought to be a result of the conservative attitude still maintained toward revival of general trade; and it is confidently expected that good business in the copper trade will immediately follow decided advance in other lines. Whether consumers are making a mistake in keeping out of the market at present prices is a matter that will develop later, but from present indications there is strong probability that the decreases of stocks here and abroad, shown in the recent report, will result in higher prices when the trade of the country becomes more brisk and copper demand increases. Opinions on the August report of the association are inclined to expect a satisfactory showing on the ground that there has been no opportunity for production to increase at a rate greatly in excess of that in July, when curtailment was enforced by excessive heat at the smelters, and this feeling is strengthened by the fact that exports for the month will be heavy, although not as large as in July. The total exports for the month, including Aug. 22, aggregate 20,637 tons. The daily call on the Metal Exchange, Aug. 22, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.10	12.30	.....
August	12.10	12.30	12.20
September	12.10	12.30	12.20
October	12.10	12.30	12.20
November	12.10	12.30	12.20

The London market Aug. 22 was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	56	5	0	56	5	0
Standard copper futures	57	0	0	57	0	0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.35c	11.57½c
London, spot	£57 10 0	£53 7 6
London, futures	58 2 6	54 0 0
Best selected	61 10 0	57 5 0

Industrial and Commercial Notes.

New York Edison Company vs. Long Acre Company.—The Public Service Commission for the First District of New York has denied the petition of the New York Edison Company for a rehearing in the Long Acre case. As set forth in these columns July 12, this petition followed approval by the commission of the Long Acre Electric Light & Power Company's application to issue $2,000,000 in stock and $4,000,000 in bonds, and requested that this authorization be withdrawn, pending a rehearing for the consideration of certain new evidence to which the petition alleged due regard was not given by the commission in previous hearings. It is understood that the New York Edison Company will take the matter to the courts and ask for a writ of certiorari, basing its appeal for reversal of the decision of the commission on the ground that the authorization of competition in a public service the full requirements of which are now being adequately supplied by the New York Edison Company is a doubtful public policy. When the Long Acre company first applied for permission to take steps to provide working capital this was refused by the commission and the company appealed to the courts, obtaining an order for a rehearing. As the case stands at the present the positions of the competing companies are reversed with respect to the attitude of the commission.

Bangor Utility Merger.—The Bangor Power Company, which has just been incorporated, as mentioned in the previous issue, to acquire the rights, franchises and properties of the Bodwell Water Power Company, will be absorbed by the Bangor Railway & Electric Company. The new company has an authorized capital stock of $1,250,000, and $750,000 in bonds; and John R. Graham, president of the Bangor Railway & Electric Company, has been chosen as general manager. Stockholders of the Bangor Railway & Electric Company will meet Aug. 26 to take up the matter of guaranteeing the $750,000 bonds of the new company and to consider the issuing of new stock for the purchase of the Bangor Power Company stock. A reorganization of the Bangor Railway & Electric Company is to be made in connection with the Bangor Power Company, the Penobscot Realty Company and the Veazie Lumber Company. This calls for increase of the capital stock of the Bangor Railway & Electric Company to $3,500,000, made up of $1,500,000 7 per cent cumulative preferred and $2,000,000 common. One share of new preferred stock and one of new common will be given to present stockholders for each $100 share of the old stock.

Stockholder Liability.—The Supreme Court, Olympia, Wash., has reversed a decision of the lower court in a case brought by T. E. Grady, receiver for the Yakima Improvement Company, against A. B. Graham for payments on unpaid stock subscription. The court holds that when bonds are issued by a corporation and it is stipulated that the stockholders cannot be held either for the principal or the interest, suit cannot be instituted against a stockholder to force payment on an unpaid subscription. In this instance the Yakima Improvement Company installed a lighting plant capitalized at $1,000,000, and issued bonds to pay for the plant, obtaining from Mr. Graham funds for partial payment and giving him stock as security. He was given $213,200 worth of stock, 5 per cent on which was paid, $202,540 remaining due. When Receiver Grady was appointed he brought suit against Mr. Graham, a jury in the lower court rendering a verdict for plaintiff of $10,000, which verdict the upper court reversed.

Telephone News Service in New Jersey.—The New Jersey Telephone Herald Company is completing its organization for furnishing telephone news service to Newark, N. J., and other cities and towns in the State. Daily news, embracing the full scope of newspaper matter, will be transmitted from a central office to subscribers' instruments as soon as received by the central office. Proceedings of public gatherings will be conveyed to subscribers through instruments placed in the auditoriums, churches, theaters, or other places where meetings are in progress. The plan is patterned after the Telefon-Hirmonde of Budapest, which has been in successful operation since 1889. The American rights to the Hungarian invention are held by the United States Telephone Herald Company, and the New Jersey Telephone Herald Company holds subsidiary rights in the State of New Jersey. The Public Utilities Commission of New Jersey has issued an order, operative September 7, directing the New York Telephone Company to furnish leased wires to the Telephone Herald Company. Negotiations for leased wires have been in progress for nearly a year, the New York Telephone Company having withheld its sanction to the lease of its wires for the purpose through fear of invalidating its franchise rights.

New Hydroelectric Developments in Oregon.—Two new hydroelectric power companies, La Tourelle Falls Power Company and the Coast Range Power Company, have recently been organized to utilize the water-power of lower La Tourelle Falls and the Nehalem River, Oregon. The plant of the former company will be located at the foot of La Tourelle Falls and will utilize both the upper and lower falls, which will aggregate a head of about 500 ft. The first installation will comprise two 200-kw, 6600-volt, three-phase, 60-cycle generators, and the energy will be sold to the town of La Tourelle and vicinity. The Coast Range Power Company will utilize the falls at the Nehalem River, below the mouth of the Salmonberry River, where it is planned to install two 750-kw turbo-generator sets. Energy will be developed at 6600 volts and 60 cycles, which will be stepped up to 44,000 volts and transmitted to Fillamoak, Ore., and to the Tualatin Valley. La Tourelle Falls Power Company will have a capital stock of $10,000 and the Coast Range Power Company $75,000. The officers of the two companies are Jerome L. Blaisdell, president, and Richard Case, secretary and treasurer, both of Portland, Ore.

Pacific Power & Light Company to Increase Capacity.—It is stated that plans are being made by the Pacific Power & Light Company for extensive hydroelectric developments in the Columbia River at Priest Rapids, southwest from Spokane, and that the ultimate capacity of the system will be 1,000,000 hp. The cost of the project is estimated at $6,000,000 to $10,000,000 and the work of construction will take over six years for completion. Advices state that a dam will be constructed at the foot of the rapids, to have a height of 75 feet, which is the drop of the river in nine miles. The plans include further work on the Hanford irrigation project owned by the company and also the building of a distribution system for supplying energy to the eastern portion of the State of Washington.

Vermont $12,000,000 Hydroelectric Project.—Interests associated with one of the Connecticut River power companies are promoting a hydroelectric project on the Deerfield River in Vermont, the initial development of which, it is reported, will approximate 25,000 hp. It is planned to dam the river at several places near Shellburne Falls, Vt., and to construct a reservoir at Somerset, Vt., where water will be impounded to a height of 100 ft. and over an area approximating six square miles. An underwriting agreement for the issuance of $3,000,000 5-per cent, forty-year gold bonds and $750,000 6-per cent cumulative preferred stock was effected in Boston early this week. The ultimate expenditures, it is stated, will aggregate $12,000,000.

Pittsfield (Mass.) Electrical Manufacturer May Move.—The Jacobson-Brandow Company, of Pittsfield, Mass., manufacturer of spark coils, is contemplating moving to Springfield, unless $50,000 additional capital can be raised in Pittsfield. It is reported that Springfield capitalists have offered to invest in the concern. The plant employs about 100 people, and the number is to be doubled if the increase in capital is effected. Bay City, Mich., has made an offer for the removal of the business there.

La Crosse Water Power Reorganization.—The outcome of reorganization of the La Crosse (Wis.) Water Power Company and the Winona (Minn.) Railway & Light Company, both of which are in the hands of receivers, as stated in recent issues of the *Electrical World*, is regarded as a consolidation between the two companies. The common stock of the Winona company is owned by the La Crosse Water Power Company. The committee representing the La Crosse bonds consists of F. O. Wetmore, vice-president of the First National Bank of Chicago; Harrison B. Riley, president of the Chicago Title & Trust Company, and Frank Vogel, president of the First National Bank of Milwaukee, the latter being chairman.

Conviction of Wireless Officials Affirmed.—The mandate of the United States Court of Appeals affirming the conviction of the three officials of the United Wireless Telegraph Company for fraudulent use of the mails in connection with sales of stock of the company was filed on Monday in the Federal Circuit Court in New York and made the order of the lower court. Christopher C. Wilson, president of the company, was sentenced to serve a term of three years at the federal penitentiary at Atlanta, and Francis X. Butler counsel and director, and W. W. Tompkins, of the New York sales agency, received sentences of two years' and one year's imprisonment respectively at the same institution. They left New York on Tuesday for Atlanta.

Holtzer-Cabot Electrical Company.—A parcel of land at Newton Highlands, Mass., has been purchased by the Holtzer-Cabot Electrical Company, of Brookline, Mass., and the purchasers plan to erect a large factory on the site. It is probable that the Boston end of the business will be transferred to the new factory, but it is not the company's intention to do away with the Brookline factory for some time to come, if at all. The land is at the junction of the Boston & Albany and New York, New Haven & Hartford railroad tracks, and the shipping facilities are excellent.

Milwaukee Manufacturers' Exposition.—The Merchants and Manufacturers' Association of Milwaukee will celebrate its fiftieth anniversary, September 2 to 12, with an exposition of Milwaukee-made products to be held in the local Auditorium. Local electrical manufacturers will display their products, and one of the features promised for the exhibition will be a "Welcome" sign made up of frost-covered brine pipes chilled by a motor-driven refrigerating machine.

Consolidation of Pennsylvania Companies.—The merging of a number of public utility companies which recently obtained charters in Pennsylvania was certified to in papers filed this week at Harrisburg by the Philadelphia Suburban Gas & Electric Company and the Luzerne Gas & Electric Company, which are two of the principal subsidiaries of the American Gas Company. Changes in management or operating methods are involved in the consolidations.

New Electric Enterprise in Mexico.—Señor José Vasconcelos, an attorney practising in Mexico City, who is acting for a group of American financiers and business men, has applied for a concession to establish an electric light and power plant in Oacaxa. The plan includes not only the lighting of the city, but also the supplying of energy to other cities and mining centers, eventually covering the greater portion of the state.

Reorganization of Hudson River Power Company.—Notice has been given to Hudson River Power Company bondholders that the reorganization plan recently submitted by the protective committee, of which J. R. Hooper, of Boston, is chairman, has become operative by virtue of approval of more than 51 per cent of bondholders concerned.

Winnipeg Rates for Energy to Be Reduced.—Announcement is made by the municipal electrical department of Winnipeg that a reduction of rates for energy supplied from the municipal plant will become effective within a month. It is stated that the new rates will be over 20 per cent less than those of the electric railway company.

Directors of Northwestern Elevated Company.—The following directors have been elected by the stockholders of the Northwestern Elevated Railroad Company of Chicago: Samuel Insull, chairman; Henry A. Blair, Ira M. Cobe, Britton I. Budd, William A. Fox, John H. Guick, W. V. Griffin, Mason B. Starring and Samuel McRoberts.

Aluminum Notes and Prices.—The aluminum market as of August 22 is reported steady, with ingots for remelting held at 20@20½ cents spot No. 1, the base for large ingots. Rods and wire are quoted at 31 cents, with sheets at 33 cents.

Financial.

The Week in Wall Street.

DECREASED apprehension over the outcome of the English labor troubles assisted in rallying the market toward the close of the last week, and it became stronger, with general recovery throughout the list. Sentiment in the street was influenced by the uncertain crop prospects in the West, and by rumors of plans for amending the Sherman law to give more direct benefit to business conditions. Discussion on the part of railroad companies of possibility of reducing dividend rates was made during the week, and denial by the management of the Union Pacific of existence of unfavorable conditions on the system were items of interest in connection with the sharp breaks in railroad stocks in the week's transactions. At the opening of the market on Monday reaction took place from the moderate improvement at the end of the preceding week, and prices fell, with Union Pacific leading the decline with a loss of 4 points. Outside buying of stocks was on a very narrow scale. The principal feature of the day's news was announcement of a retrenchment plan on the part of the Harriman lines, with a view to adjusting the cost of operation to gross receipts. Prices recovered on Tuesday, following a sharp decline at the opening, and the general trend of the day's transactions was upward. Trading was largely professional and listless throughout. No particular attention was given to the adjournment of Congress. The government's weekly report on weather conditions in crop districts was favorable in the main, and its publication was followed by declines in the cotton and wheat markets. The most important news received on the street during the day was of temporary suspension of work on some of the Harriman roads. From the action of the market on Tuesday, opinions were inclined to belief that liquidation has run its course, and that the favorable aspect now shown by business conditions throughout the country indicates substantial recovery in the stock market, with public participation before fall. Rates in the money market Aug. 22 were as follows: Call, 2@2¼ per cent; ninety days, 3@3¼ per cent. The quotations in the tables are those at the close Aug. 22.

NEW YORK.

	Aug. 15.	Aug. 22.	Shares Sold		Aug. 15.	Aug. 22.	Shares Sold
All. Ch.....	6¾*	6½	100	Int. Met., pf.	43½	42½	6,700
All. Ch., pf..	20	20*	400	Mackay Cos..	83	83⅛	490
Amal. Cop...	62	61	140,150	Mackay C.,pf.	72*	72*	90
Am. D. T....	20½*	20½*	———	Man. Elev...	135*	135*	600
Am. Loco...	37*	36¼	2,100	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	107½	107*	50	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	79¾*	79¾*	———	Steel, com..	73¾	72⅞	943,550
Am. T. & T..	134⅝	133¾	8,315	Steel, pfd...	115¾	115¾	13,400
B. R. T.....	75¾	75¾	17,200	W. U. T....	74½	75	10,165
Gen. Elec....	154½	153	3,520	West'h, com.	65½	66	5,700
Int. Met.....	15½	15⅜	9,450	West'h, pfd..	118¼*	112	300

PHILADELPHIA.

	Aug. 15.	Aug. 22		Aug. 15.	Aug. 22.
Am. Rys.....	44½*	45	Phila. R. T.....	23	23
El. Co. of A.....	11⅞	11⅞	Phila. Elec.....	17⅝	17⅛
Elec. St. Bt'y.....	52⅝	52¾	Phila. Trac.....	86*	86*
Elec. St. Bt'v., pf..	30*	30*	Union Trac.....	51	50¾

CHICAGO.

	Aug. 15.	Aug. 22.		Aug. 15.	Aug. 22.
Chi. City Ry.....186*		186*	Com. Edison.....132		133
Chi. Elev. Rys.....	25*	25	Chi. Subways.....	2¾*	2⅞
Chi Elev. Rys., pf..	93*	90	Chi. Tel. Co.....123*		123*
Chi. Rs., Ser. 1....	95*	95*	Nat'l Car.....110½*		101*
Chi. Rs., Ser. 2....	30	29¾*	Nat'l Car, pfd.....118½*		118½*

BOSTON.

	Aug. 15.	Aug. 22.		Aug. 15.	Aug. 22.
Am. T. & T.....134½		133⅞	Mex. Tel.....	4¼*	4¼*
Cum. Tel.....156		156*	Mex. Tel., pfd.....	6*	6*
Edison E., Il.....286½		286½*	N. E. Tel.....147½*		146½
Gen. Elec.....153½		153½	W. T. & T.....	18¼	18¼*
Mass. E. Ry.....	19¾*	18¼*	W. T. & T., pfd....	96½*	98
Mass. E. Ry., pf...	91	88½*			

*Last price quoted.
Shares sold for the week, Aug. 14 to Aug. 19.

Financial Notes.

Court Decision on Non-Negotiable Bonds.—The Superior Court, Sacramento, Cal., has handed down a decision against the Sacramento Electric, Gas & Railway Company, holding it responsible for the payment of sixty-five $1,000 gold bonds, which were stolen in 1905 from the California Safe Deposit & Trust Company, San Francisco, by the bank's general manager, J. D. Brown, subsequently tried and convicted for the theft. The suit was instituted by Isaac Kohn, a stock broker of San Francisco, who handled the bonds, on which he obtained loans aggregating $60,000. The Sacramento Electric, Gas & Railway Company contended that the bonds were not negotiable instruments, and had so warned the holders, but the court in its decision makes a statement to the following effect: "It would create an unfortunate financial condition if all corporation bonds in the State were held non-negotiable by reason of a reference therein to a securing mortgage or deed of trust containing some provision which alone might affect such bonds. The effect of such decision would be to depreciate greatly the value of all corporation bonds in the State, because it would greatly lessen the facility with which banks, stockholders and business men deal therein, because without a thorough examination of such security preceding such transaction they would always take the bonds at their own risk and subject to any equities in favor of the corporation issuing the same or the real owner from whom they might have been wrongfully taken. The plaintiffs were innocent purchasers of the bonds for value; * * * the fact that Brown stole the bonds cannot, under the facts shown here, defeat the plaintiff's right to recover."

Initial Dividend of Chicago Elevated Railways.—Payment of the initial quarterly dividend of 1½ per cent on the cumulative preferred stock of the Chicago Elevated Railways is to be made about Dec. 1. The consolidation was effective as of July 1, but the fiscal affairs of the new company are not begun until Sept. 1. The two months intervening have been required to adjust the accounts of the several companies, secure formal possession of their properties, and for completion of a preliminary organization for operation of the roads. Although $16,000,000 of the Chicago Elevated Railways preferred stock is outstanding, there is only some 6 per cent of the total held by former stockholders in the old companies. The balance of the stock is in the hands of the syndicate that furnished the funds used for payment of the old stocks. Annual requirements for preferred dividends will amount to $960,000. Stockholders of the Northwestern Elevated Railroad at special meeting Aug. 21 ratified the proposal authorizing an issue of $25,000,000 first mortgage bonds. The trustees of the Chicago Elevated Railways voted nearly all of the capital stock of the company. The bonds are to be turned over to the trustees and will be held as security against money advanced for retiring some $19,000,000 4 per cent mortgage bonds on Sept. 1, and also to liquidate floating indebtedness. It is said that none of the bonds will be offered to investors.

Canadian General Electric Company.—The report of the Canadian General Electric Company for the year ended December 31, 1911, shows operating profits of $911,208, as compared with $625,990 in the year preceding. Deductions for interest were $76,820, as against $51,660, and the deductions for depreciation were $188,088, as compared with $91,093. The balance available for dividends was $646,300, as against $483,237, and after payment of $140,000 on the preferred stock and $354,625 on the common, there was a surplus of $151,675, comparing with $14,237 in the previous year. The amount available for dividends on the common stock was equal to 9.39 per cent earned on $5,392,737 common, as compared with 7.30 per cent earned last year on $4,700,000 common stock.

Pacific Light & Power Corporation.—A special stockholders' meeting of the Pacific Light & Power Corporation has been called for Oct. 9 for the purpose of increasing the bonded indebtedness from $3,000,000 gold bonds to $38,000,000, an increase of $35,000,000. The corporation has assumed the outstanding bonded indebtedness of the Pacific Light & Power Company and certain subsidiary companies to an amount approximating $9,015,000, together with the $3,000,000 issue stated, which is of five-year duration, bearing 6 per cent. The new issue is to be evidenced by 35,000 bonds of par value of $1,000 each, of the same term and bearing the same interest as the previous collateral trust bonds.

Opposition to Stock Issue in Ohio.—W. R. Kimball, president of the Cuyahoga River Power Company, has filed a protest with the Ohio Public Service Commission against the issue of $3,000,000 stock by the Northern Ohio Traction & Light Company. It is alleged in the petition that the proposed stock issue would be contrary to the provisions of the public utilities act which became effective June 30, giving full power over stock issues to the state commission, and that part of the issue has been sold to a co-director at less than par. It

is also alleged that part of the proceeds have been diverted, and that circulars issued by a New York banking house contain misrepresentations.

Washington, Baltimore & Annapolis Earnings.—That the Washington, Baltimore & Annapolis Electric Railroad Company is maintaining its good earning record is evidenced by report of earnings for the month of July, which has been just issued. During the month both gross and net income of the property increased over the figures for the corresponding month of 1910. The gross operating revenue of the company for July was $60,142, as compared with $57,202, making a gain of $2,940,778 for the present year. Operating expenses for the period were $30,348, as against $28,393 for July of 1910, or an increase of $1,954 for last month. The net operating revenue of the company was $29,794, as compared with $28,808 for 1910, the increase being $986 for July of this year. For the four months of the company's new fiscal year, which began on April 1, the reorganization plan becoming effective at that time, the gross operating revenue of the road was $242,714, as against $236,249 for 1910, the increase for this year being $6,465. The net operating revenue was $127,613, as against $118,231 for 1910, or a gain of $9,382 for the four months of the current year. The gross income of the Washington, Baltimore & Annapolis for the period mentioned, including miscellaneous income, was $128,171, as against $118,497 for the corresponding period of the previous year, while the net income was $38,660, as compared with a deficit of $4,676 for last year. The percentage of operating expenses to gross operating revenue for the four months was 47.42 per cent, as against 49.96 per cent for 1910.

Mountain States Telephone & Telegraph Company.—Boettcher, Porter & Company, of Denver, Col., own and offer the stock of the Mountain States Telephone & Telegraph Company, now paying 7 per cent per annum on the par value of $100 per share. This company, the outcome of a merger between the Colorado Telephone Company, the Tri-State Telephone & Telegraph Company, and the Rocky Mountain Bell Telephone Company, as outlined in recent issues, owns and controls the telephone properties of six states, and crosses the borders of two others, operating in Colorado, Utah, Idaho, Montana, Wyoming and New Mexico, with toll lines extending into the surrounding territory. The reorganization has been effected by acquisition of the stock of each constituent company, with the transfer to the new company of all physical and other properties, franchises, good-will, etc., of the three former companies. The Mountain States company has an authorized capital of $50,000,000, par value of each share being $100, fully paid and non-assessable; issued and outstanding $18,937,400. There is but one class of stock and no bonded or floated debt. The prime purpose of the merger has been to bring all telephone properties in the Rocky Mountain region under one management and ownership. The Mountain States company has a surplus, undivided profits and depreciation reserve of $4,208,261. Price of the stock will be furnished upon application to Boettcher, Porter & Company.

Fort Worth Power & Light Bonds.—Perry, Coffin & Burr are offering $1,500,000 first mortgage 5 per cent gold bonds of the Fort Worth Power & Light Company, which does the entire electric light and power business of Fort Worth, Texas. The issue is secured by a direct first mortgage upon all the properties, rights and franchises of the Fort Worth company, now owned and hereafter acquired. The authorized first mortgage bond issue is $10,000,000, of which $1,500,000 bonds are being issued for the present time. The remaining $8,500,000 in escrow may be issued from time to time to the par value of 80 per cent of the cost of permanent extensions and improvements to the property, provided that net earnings for the preceding twelve months have been equal to at least twice the interest on all bonds outstanding, including those it is proposed to issue. A deposit of $000,000 of the proceeds of the present issue will be made with the trustee, to be expended on the construction of a modern power station. The company has recently obtained a contract with the city of Fort Worth for furnishing energy to the new city pumping stations and has a city contract for street lighting. Net earnings exceed twice interest requirement on the present bond issue.

Union Railway, Gas & Electric Bonds.—E. W. Clark & Company, of Philadelphia, are offering $3,000,000 5 per cent collateral trust convertible gold bonds of the Union Railway, Gas & Electric Company at 93 and accrued interest. The company owns and controls one hundred and thirty-four miles of track comprising the street railway system of Springfield, Ill., and a number of street railways and interurban lines in neighboring towns, and also the gas, electric-lighting and electric-power properties in the territory served. The bonds are dated July 1, 1909, and mature July 1, 1939; are convertible at any semi-annual interest period into 6 per cent cumulative preferred stock on thirty days' notice, and are redeemable at par and interest on any interest date.

Dividend Dates of Southern California Edison Company.—John B. Miller, president of the Southern California Edison Company, has announced that on account of opening a transfer office in New York City it has become necessary to designate permanent dates for payment of dividends, and that the directors have accordingly authorized the following dates, contingent upon the earnings of the company: Dividends to holders of preferred stock as shown on the books at the close of business on the last days of March, June, September and December, checks to be forwarded therefor on the 15th of April, July, October and January; dividends to holders of common stock of record on the last days of January, April, July and October, checks to be forwarded therefor on the 15th of February, May, August and November.

Hamilton Gas & Electric Company.—Bondholders of the Hamilton Gas & Electric Company, of Hamilton, Ohio, have selected W. E. Hutton, of Cincinnati; Stanley Matthews and Joseph Kelly as a committee to make an investigation into the operation of the company with a view to suggesting methods of safeguarding the interests of the bondholders. The company has been unable to pay the interest on outstanding bonds, as, it is claimed, the company has been operating its plant at a loss for some time. This is said to be due to competition with the gas and electric plant operated by the city of Hamilton. The company now has a suit pending against the city to prevent its operating at the present rates, which are claimed to be so low that the city is sustaining a loss.

Marconi Wireless Company Dividends.—At a recent meeting in London the Marconi Wireless Telegraph Company, Ltd., declared dividends as follows: 7 per cent per annum on the cumulative participating preference shares issued on or prior to December 31 last, and an interim dividend at the rate of 7 per cent per annum on the cumulative participating preference shares issued on or prior to June 30 last, and also an interim dividend for the half year ended June 30 at the rate of 10 per cent per annum on the ordinary shares issued July 20, 1911; all dividends payable September 1.

Philadelphia Electric Company.—The income of the Philadelphia Electric Company has been increased during the year by the increased sale of energy for municipal lighting and further additions to the revenue will be made by the contract to supply energy to the Philadelphia Rapid Transit Company. It is expected that the company will end its fiscal year on December 31 with a very large surplus.

DIVIDENDS.

Mackay Companies, quarterly, preferred, 1 per cent; common, 1¼ per cent, payable Oct. 2.

New York & Queens Electric Light & Power Company, quarterly, 1 per cent, payable Sept. 1.

Standard Gas & Electric Company (Chicago), quarterly, preferred, 2 per cent, payable Sept. 15.

REPORTS OF EARNINGS.

CHICAGO & MILWAUKEE ELECTRIC RAILWAY COMPANY.

Period.		Gross Earnings	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
6m., June,	'11	$405,776	$293,237	$120,219	$59,305	$60,914
" "	'10	390,807	338,002	59,515	55,825	3,690

COLORADO SPRINGS LIGHT, HEAT & POWER COMPANY.

July,	1911	$210,899	$120,612	$90,287	$46,805	$43,482
"	1910	202,329	114,500	87,829	44,142	43,687

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

July,	1911	$369,872	$172,044	$197,828	.....	.....
"	1910	332,594	155,318	177,276	.....	.....

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

July,	1911	$366,902	$185,333	$181,569	$122,773	$58,796
"	1910	341,590	170,765	170,825	106,453	64,372
7m., July,	'11	2,708,964	1,350,881	1,358,083	797,595	560,488
" "	'10	2,448,651	1,167,877	1,280,774	717,151	563,623

General News

Construction News.

ANNISTON, ALA.—The Anniston Realty Company is planning to build a stventeen-acre park and extend electric-lighting system, etc. H. F. Williamson is interested in the company.

CEDAR BLUFF, ALA.—The installation of an electric-light plant in Cedar Bluff is reported to be under consideration. W. T. Lassiter is interested in the project.

COLUMBIANA, ALA.—The franchise granted to G. L. Carlisle and associates several months ago has been acquired by the Mount Dixie Sanatorium, Land & Investment Company, which, it is said, will construct an electric-light plant.

STEVENSON, ALA.—The City Council is reported to have engaged J. B. McCrary & Company, Empire Building, Atlanta, Ga., to pre are plans for a municipal electric and water plant.

MIAMI, ARIZ.—The Summit Copper Company is planning to install an electric-light and power plant.

PHOENIX, ARIZ.—The City Council has awarded a contract to the New State Electric Company for the installation of an ornamental lighting system in the business district of the city, to cost about $20,000. Iron lamp standards and incandescent lamps will be used.

PHOENIX, ARIZ.—Contracts have been awarded by the Salt River Valley Water Users' Association for equipment for its power house at Arizona Falls, as follows: To the S. Morgan Smith Company, of York, Pa., for 725-hp hydraulic turbines, at $11,500; for 530-kva alternators to the General Electric Company, of Schenectady, N. Y., at $15,462, and to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for switchboard, for $3,222.

CLARKSVILLE, ARK.—The proposition to issue bonds to the amount of $75,000, the proceeds to be used for the installation of an electric-light plant, water-works and sewer system, will be submitted to a vote of the people. Plans for electric-light plant have been prepared by R. L. Goodman.

ALAMEDA, CAL.—An election will soon be held in this city to vote on a $15,000 bond issue, the proceeds to be used for improvements to the electric-light plant

ALPAUGH, CAL.—Plans are being prepared by the Second Extension Water Company for the installation of an electric pumping plant.

ANAHEIM, CAL.—Plans are being considered for the installation of an ornamental street-lighting system in the business district of the city. It is proposed to erect ornamental lamp standards, each standard carrying five lamps.

COLUSA, CAL.—The County Supervisors of Colusa County have granted the Northern California Power Company a franchise to erect transmission lines to supply electricity for lamps and motors throughout the county.

LODI, CAL.—The Central California Traction Company, it is reported, is contemplating the construction of a railway from a point near Lodi up Dry Creek. Extensions are also planned to Jackson and Sutter Creek.

LONG BEACH, CAL.—Preparations are being made by the Pacific Telephone & Telegraph Company for the erection of a new exchange building on Fifth Street and to install a conduit system to cost approximately $140,000.

LONG BEACH, CAL.—The Southern California Edison Company has completed the installation of the initial 15,000-hp unit at its power plant, which will be put in operation immediately. The cost of the plant to date is approximately $2,000,000.

LOS ANGELES, CAL.—Preparations are being made by the Pacific Telephone & Telegraph Company for improvements and additions to its exchange building, located on East Jefferson Street, for which a permit has been granted.

LOS ANGELES, CAL.—The Southern California Edison Company is erecting a new transformer house in the Lawnsdale district.

LOS ANGELES, CAL.—In the city budget for 1911-12 adopted by the City Council the sum of $92,855 is appropriated for the installation of a modern fire and police telegraph system.

LOS ANGELES, CAL.—The Los Angeles Railway Corporation announces that it will build new car lines on West Jefferson Street and Vermont Avenue if suitable franchise is given.

LOS ANGELES, CAL.—Parkinson & Bergstrom, architects, Security Building, have awarded a contract to the Meyberg Company, Sixth and Spring Streets, for furnishing and installing electric fixtures in the twelve-story Chester Building, at Fifth and Spring Streets, for $5,650.

LOS ANGELES, CAL.—The City Council on Aug. 8 decided to appropriate $5,500 for August and $5,000 for September, to cover the expenses of securing rights-of-way and making surveys for transmission lines and locations for power houses in connection with the development and transmission of the city's electrical supply, and William Mulholland, chief engineer of the aqueduct, will file on additional power sites on the Owens River and on Cottonwood Creek that will increase the rating of the aqueduct by 30,000 hp.

MARYSVILLE, CAL.—Plans are being considered by the Great Western Power Company for extension of its transmission lines to Marysville to supply electricity for lamps and motors. The erection of a new power plant on the outskirts of the city is contemplated.

NAPA, CAL.—Application will be made by the Napa & Clear Lake Railway Company for a charter to construct an electric railway from Napa to Lakeport, 90 miles in length. The company is to be capitalized at $500,000. The directors are: C. W. Conlisk, W. M. Rank and R. A. Morton.

OAKLAND, CAL.—The Blue Lakes Power & Lighting Company is erecting a transmission line across the hills from Lake County with the view of extending it to Oakland and ultimately to San Jose and then up the peninsula, via Palo Alto to San Francisco.

PALMS, CAL.—At an election held recently the proposition to install a street-lighting system in Palms was carried.

REDONDO BEACH, CAL.—The Pacific Light & Power Company has awarded the contract for the installation of a new piping system in its power plant to H. R. Boynton, to cost $11,619.

RIVERSIDE, CAL.—The Southern Sierras Power Company, which is reported to have awarded contracts for the erection of distributing lines throughout this county, one of which will tap the Moreno and Pervis country and another the West Riverside and Corona districts, is planning to build a transmission line from San Bernardino to Bishop, a distance of 250 miles. The cost of the line is estimated at $2,000,000. F. A. Worthley, of Riverside, Cal., is local representative.

ROSEVILLE, CAL.—The installation of a municipal electric-lighting system in Roseville is reported to be under consideration.

SACRAMENTO, CAL.—The Sacramento Valley West Side Electric Railway Company has awarded the contract for construction of its proposed electric railway from Woodland to Red Bluff to the Dozier Construction Company, of Sacramento, Cal.

SACRAMENTO, CAL.—Bids for the installation of the new underground conduit system for the lighting arrangements on the Capitol grounds and the building were opened on Aug. 12 by Capitol Superintendent Radcliff, and all bids are reported to be higher than the estimate, which is about $13,000. New bids may be called for.

SAN BERNARDINO, CAL.—The Southern Sierras Power Company has purchased a site for its large power plant, which is to be located at Poplar Street and the intersection of the Santa Fe tracks. A steam plant will be installed immediately and operated until the transmission line from Bishop to San Bernardino is completed, after which the steam plant will be used as an auxiliary.

SAN BERNARDINO, CAL.—The California-Nevada Power Company has awarded a contract to Milliken Brothers, of New York, N. Y., for 2000 steel towers, and to the Aluminum Company of America for 1175 tons of wire for its proposed transmission line from Bishop to San Bernardino, a distance of 240 miles. The Southern Sierras Power Company, a subsidiary company, has acquired a site in this city for a steam auxiliary and distributing plant. A conduit system will be installed in the business section. The cost of the work is estimated at about $300,000.

SAN FRANCISCO, CAL.—The site for the new power house of the Geary Street Railway at Jefferson and Jones Streets has been purchased for $55,000. Plans are now being prepared for the building.

SAN JOSE, CAL.—The Great Western Power Company has applied to the Board of Supervisors of Santa Clara County for a franchise covering the entire county.

VACAVILLE, CAL.—The Board of Supervisors has granted the Pacific Portland Cement Company a franchise to maintain an electric transmission line on the county road in Vacaville.

WINTERS, CAL.—In order to be able to take care of its increasing business in this city, the Pacific Gas & Electric Company has arranged to reconstruct its entire system, and work has already been commenced.

JULESBURG, COL.—An electric pumping plant installed at Ralston, Neb., a siding on the Union Pacific Railroad, by L. W. Fersman and H. C. McNew, having proved successful, it is proposed to erect a plant in the vicinity of Julesburg, the electrical energy from which will be used for the operation of the various pumping equipments in Sedgwick County.

LONGMONT, COL.—George H Stonex, City Clerk, writes that F. H. Whiting, 236 Central Building, Denver, is preparing plans for the municipal electric-light plant, which is to cost $60,000. R. E. Richardson is city engineer.

PUEBLO, COL.—The Trinidad Transmission Railway & Gas Company has been incorporated with a capital stock of $4,000,000 to engage in

the electric-lighting and street-railway business in the State of Colorado and to furnish lighting and motor service to cities, towns, individual firms and corporations for domestic and commercial purposes. The company recently took over the properties of the Southern Colorado Railway, Light & Power Company and will operate in Las Animas, Heurfano, Pueblo, Fremont and Denver Counties. Those responsible for its formation are: C. H. Williams, R. H. Widdecamp, John M. Cates, C. W. Collins and A. S. Brooks.

NORFOLK, CONN.—The installation of a new electric lighting plant for Norfolk is under consideration, a site on the Blackberry River having been surveyed for the purpose. It is understood that Mrs. George W. Jenkins, a summer resident of Norfolk, is back of the enterprise.

SOUTH NORWALK, CONN.—Beginning with November, the Municipal Electric Light Plant will make the following reduced rates to consumers of electrical energy: For public lighting the price of arc lamps is to be reduced from $60 to $54 per year, and the price of incandescent lamps from $13.20 to $10.80 per year, public offices and buildings to be supplied with energy at actual cost. For commercial service the rates will be from 9 cents per kw-hour for the first 100 kw-hours to 5 cents per kw-hour for all over 500 kw-hours, the present rates running from 10 cents for all over 300 kw-hours. The minimum rate for business establishments will be $1.11 and for residences 55 cents. For industrial purposes the rates will be 5 cents per kw-hour for the first 100 kw-hours, 4 cents for the next 400 kw-hours and 3 cents for all over 500 kw-hours, with a minimum rate of $1.11.

WASHINGTON, D. C.—Consular Report No. 186 states under Foreign Trade Opportunities, Item No. 7166, that a firm in England informs an American consular officer that it wishes quotations from manufacturers of electrolyte wire bars in the United States.

WASHINGTON, D. C.—Consular Report No. 187 states under Foreign Trade Opportunities, Item No. 7166, that an American consular officer in England has forwarded the name of a business man in his district who wishes to communicate with manufacturers of motors and electrical accessories in the United States with a view of obtaining the agency in that line.

WASHINGTON, D. C.—Consular Report No. 193 states, under the head of British Columbia Activities, that it is understood that the Great Northern Railway Company will install at Ardley, British Columbia, where the Burnaby line of the British Columbia Electric Railway crosses its tracks an interlocking plant at a cost of over $7,000, which will provide for switching from line to the other.

FORT McCOY, FLA.—The installation of an electric-light plant, ice plant and water-works system is reported to be under consideration. George Rentz is interested in the project.

SANFORD, FLA.—Plans are being formulated by Judge Bullock, of Ocala, and a group of capitalists for the organization of an electric-power company at this city. The purpose of the proposed enterprise is to establish a generating plant on the Wekiwa River, from which point electrical energy can be distributed to the nearby towns.

DALTON, GA.—Surveys are being made for the erection of the transmission lines of the Eastern Tennessee Power Company east of Dalton, the main line running just outside of the city limits. If granted a franchise the company will supply electricity in Dalton. The company is developing the water power of the Ocoee River.

NEWNAN, GA.—C. T. Clifford, of Columbus, Ga., has secured the contract for rebuilding the power house of the Virginia-Carolina Chemical Company, of Richmond, Va.

BOISE, IDAHO.—The city of Boise is planning to install a cluster lighting system, which will double the area covered by the present system and involve the erection of 540 additional poles, each surmounted with a cluster of three lamps. It is stated that the maintenance of the new installation will cost the city $3,000 more per year than it is paying for the present system.

STITES, IDAHO.—Application has been made to the City Council by D. E. Frank, manager of Kooskia Milling & Power Company of Kooskia, for a franchise to supply electricity in Stites for lamps and motors. The company proposes to erect a transmission line from its plant in Kooskia to Stites and agrees to furnish electrical service at the same rates as charged in Orofino. If granted a franchise Mr. Frank agrees to have the system ready for operation within thirty days.

AURORA, ILL.—The Fox & Illinois Union Railway Company is planning to begin work on the construction of its proposed electric railway between Yorkville and Morris, 20 miles in length, about Sept. 1. H. H. Evans, of Aurora, Ill., is president of the company.

BATAVIA, ILL.—The Aurora, Elgin & Chicago Railroad Company is contemplating the installation of a coal-handling and coal-storage plant at its Batavia power house.

CHICAGO, ILL.—At a special meeting of the stockholders of the Northwestern Elevated Railroad Company held recently a $25,000,000 bond issue was authorized, the proceeds to be used to retire $19,000,000 in bonds due September, and to pay floating indebtedness.

CHICAGO, ILL.—The Chicago Railways Company has awarded the contract for equipment for the extension of its La Salle Street substation, including two 3000-kw, 25-cycle, self-starting rotary converters, with necessary transformers and a three-panel switchboard, to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.

CHICAGO, ILL.—Bids will be received by William Carroll, city electrician, 608 City Hall, Chicago, Ill., until Aug. 28 for furnishing the city of Chicago with lamps on certain parts of streets in different sections of the city for one year from Sept. 1, 1911, as per specifications on file in the office of the city electrician. Alternate propositions will be received covering a period of two, three and five years from Sept. 1, 1911; also alternate proposals covering a period of one, two, three and five years from Jan. 1, 1912.

MASCOUTH, ILL.—The citizens have voted in favor of a $12,000 bond issue, the proceeds to be used for the construction of a municipal electric-light plant, as mentioned in a previous issue.

PAXTON, ILL.—The question of establishing a municipal electric light plant in Paxton is under consideration, and bonds to the amount of $15,000 have been authorized.

TAYLORVILLE, ILL.—A contract has been awarded by the Taylorville Gas & Electric Company to John W. Morrison, of Lincoln, for the construction of a new electric-light plant on the site of the old plant. Not only will a new structure be erected, but the plant will be entirely equipped with new machinery, which will displace that which has been in use for some time.

ALBION, IND.—At an election held recently the citizens voted to purchase the local electric-light plant and water-works system, to be owned and operated by the municipality.

ELKHART, IND.—The City Council is considering an ordinance which provides for installing electric wires in conduits in the business district of Elkhart.

EVANSVILLE, IND.—Negotiations have been closed by the Evansville Railways Company, which operates traction lines from Evansville to Grandview, Ind., and Mount Vernon, Ind., for leasing the abandoned tracks of the Illinois Central Railroad from Evansville to Henderson, Ky. The Evansville company will operate electric cars on the line and expects to have the system in operation in about three months. Eventually the Evansville Railway Company will extend the railway from Henderson to Owensboro, Ky.

GARY, IND.—It is stated that the $10,000,000 plant which the American Car & Foundry Company is to erect in Gary will be electrically equipped throughout.

INDIANAPOLIS, IND.—The Commissioners of Marion County are not favorably impressed with municipal operation of utility plants, and will close the power, light and heating plant which has been supplying the jail and court house with water, heat and light. It is the belief of the commissioners that the county can buy its water, heat and light at a rate that would be lower than the cost of maintaining its own power plant. Bids are now being asked of the existing companies to furnish such service.

NEWCASTLE, IND.—A five-year contract to supply electrical energy to the Indiana Village of Epileptics, for the operation of lamps and motors, has been awarded to the New Castle Light, Heat & Power Company.

CLARION, IA.—The local electric-light system, which was recently destroyed by fire, has been purchased by Messrs. Morengo and Mack. It is understood that the new owners will rebuild the plant.

COUNCIL BLUFFS, IA.—Bids will be received by the Board of Water Works Trustees of Council Bluffs, Ia., until Sept. 7, for furnishing complete two 100-hp, three-phase, 60-cycle, 2000-2300-volt induction motors, in accordance with plans and specifications on file at the office of the superintendent of water works, Des Moines, Ia., copies of which may be obtained on application to S. L. Entyre, superintendent of water works. Bids will also be received at the same date and place for the construction of concrete reservoirs and also for 5000 barrels of Portland cement.

DES MOINES, IA.—The city is reported to be considering the question of taking over the electrolier lighting system.

DES MOINES, IA.—Plans are being considered by the Des Moines City Railway Company for the erection of an addition to its power plant in Des Moines.

MARSHALLTOWN, IA.—The recently organized Merchants, Mechanics & Farmers Telephone Company will award a contract in September for the construction of a plant that will cost in the neighborhood of $100,000.

NEW SHARON, IA.—Owing to the Town Council and the owners of the local electric-light and water plants being unable to come to an agreement, the plants have been closed and the town is without street-lighting service and fire protection. Announcement has been made that the town authorities will take charge of the lighting and pumping plants and operate them until the courts settle the controversy.

HILL CITY, KAN.—The J. S. Worley Company, Reliance Building, Kansas City, Mo., is reported to be preparing plans for the installation of an electric-light plant and water-works system in Hill City, to cost approximately $50,000.

KANSAS CITY, KAN.—Plans and specifications for the installation of a municipal electric light plant in this city, drawn by the McLaughlin Engineering Company, have been approved by the Commissioners, and that the City Clerk has been instructed to advertise for bids for its construction.

SYLVAN GROVE, KAN.—It is reported that plans and specifications are being prepared by Von Unwerth & Cooke, Finance Building, Kansas City, Mo., for the installation of an electric-light plant and water-works system in Sylvan Grove, for which bonds to the amount of $35,000 have

been voted. The cost of the electric plant is estimated at $10,000 and the water works at $25,000. It is understood that bids for construction of the systems will be called for in the near future.

O'BANNON, KY.—The residents of the eastern part of Jefferson County are considering the organization of a light, heat and power company to operate in this section of the county. It proposes to locate at Marcia, where the old plant of the Louisville & Eastern Electric Railroad is located, which has been abandoned by the Louisville Railway Company, which took over the former company. It is understood that the railway company is anxious to sell the property. It is proposed to organize a company with a capital stock of $60,000.

NEW IBERIA, LA.—The Southwestern Traction & Power Company, of New Orleans, La., will place contracts during the next ten weeks for the construction of a new power house in New Iberia. The equipment will include two 250-hp water-tube boilers, turbines, generators, etc. Oil will be used for fuel for boiler.

BANGOR, MAINE.—The Bangor Power Company, recently incorporated for the purpose of acquiring the property and franchises of the Bodwell Water Power Company, is to be absorbed by the Bangor Railway & Electric Company. A dam is soon to be built at Gilman's Falls, on the Stillwater branch of the Penobscott River, for which surverys are now being made. John R. Graham, president of the Bangor Railway & Electric Company, has been elected general manager of the Bodwell Power Company.

BANGOR, MAINE.—The Bangor Power Company was recently incorporated with an authorized capital stock of $1,250,000 and $750,000 in bonds, to take over the rights, property and franchise of the Bodwell Water Power Company, which was purchased at a foreclosure sale on May 19 by the reorganization committee. A meeting of the Bangor Railway & Electric Company will be held Aug. 26 to consider the guaranteeing of the $750,000 bonds of the Bangor Power Company, and also the issuing of new stock for the purchase of the stock of the Bangor Power Company. It is proposed to reorganize the Bangor Railway & Electric Company in connection with the Bangor Power Company, the Veazie Lumber Company and the Penobscot Realty Company. The plan calls for an increase in the capital stock of the Bangor Railway & Electric Company to $3,000,000.

WILTON, MAINE.—Charles O. Sturtevant, general manager of the Franklin Electric Light & Power Company of Farmington, Maine, has purchased the plant and holdings of the Wilton Electric Light, Power & Gas Company. The Town Council has contracted with the Franklin Company to supply electricity for lighting the town. Thirty street lamps will be erected in the villages of East Wilton and Wilton. Work will soon begin on the erection of the transmission line from Farmington to Wilton.

BOSTON, MASS.—Plans are being considered by Mayor Fitzgerald for the installation of an electric-light plant in the new city hall annex to supply electricity for lighting the city hall and annex and possibly the nearby buildings. It is also proposed to light Gallup's Island quarantine station with electricity.

DEDHAM, MASS.—The Dedham & Hyde Park Gas & Electric Light Company has petitioned the Massachusetts Gas and Electric Light Commissioners for permission to issue additional capital stock to the amount of $14,200, the proceeds to be used to pay for extensions and additions to its mains and services, and to provide funds for further extensions.

NORTH ADAMS, MASS.—The stockholders of the Hoosac Cotton Mills have authorized the erection of a new spinning mill, power house and other buildings at their Eclipse plant and the removal of machinery of their Beaver plant to the new mill. An increase of capital stock from $750,000 to $1,000,000 has also been authorized.

WARE, MASS.—The Ware Electric Company has applied to the Massachusetts Gas and Electric Light Commissioners for permission to issue $40,000 additional capital stock, the proceeds to be used to pay floating indebtedness for new construction and improvements already made and for developments to the property.

WEYMOUTH, MASS.—The Massachusetts Gas and Electric Light Commissioners have approved the petition of the Weymouth Light & Power Company to issue new capital stock to the amount of $210,000, the proceeds to be ustd to pay for additions made to its plant.

STANTON, MICH.—At a special election held recently the proposition to issue $10,000 in bonds, the proceeds to be used for the construction of an electric-light plant and water-works system, was carried.

ALBERT LEA, MINN.—Improvements are contemplated by the Northwestern Telephone Exchange Company to its new system, which will involve an expnediture of about $10,000.

DEER RIVER, MINN.—The Everton Light & Power Company has commenced work on the construction of a new electric-light plant in Deer River.

RUSH CITY, MINN.—The Village Council of Rush City, Minn., will receive sealed bids for an electric fire pump and motor up to Sept. 5. Detailed information may be obtained from the Village Recorder, J. F. Sommers.

ST. PAUL, MINN.—It is reported that the Board of Public Works has decided to install a new street-lighting system. About 1000 new lamps will be erected.

WINONA, MINN.—Judge Charles A. Willard, of the U. S. District Court, has appointed Howard Norris, of Milwaukee, receiver of the Winona Railway & Light Company. C. C. Smith, for the receivers, offered a cash payment of $12,375 as default interest to the Old Colony Trust Company, of Boston, as a plea that the receiver be not appointed, but the attorney, acting for the Trust Company, objected to its acceptance on the ground that it was not offered in good faith.

KIRKWOOD, MO.—At an election held Aug. 19 the proposition to issue $10,000 in bonds, the proceeds to be used for improvements and extensions to the electric-light plant and water-works system, was carried.

MONETT, MO.—Bids will be received for the construction of an electric-light plant, including pole line, etc., until Aug. 29. The cost of the plant is estimated at approximately $35,000.

PRINCETON, MO.—Bonds to the amount of $7,000 have been voted, the proceeds to be used for extensions to water-works and electric-light systems.

ROLLA, MO.—The proposition to issue bonds to the amount of $8,000, the proceeds to be used for improvements to the municipal electric-light plant, will be submitted to a vote of the people.

BIG HORN, MONT.—The Big Horn Telephone Company, recently organized with a capital stock of $20,000, is planning to erect a telephone line to Custer, Mont.

BILLINGS, MONT.—The City Council has passed an ordinance providing for the installation of an ornamental street-lighting system in Billings.

LIBBY, MONT.—Plans are being considered by J. A. Coram, of Boston, Mass., for the installation of a power plant at Kootenai Falls.

BURWELL, NEB.—Preliminary arrangements for the installation of an electric power plant at this city having been concluded by Messrs. Reasoner and Beardsley, of Lincoln, work on its construction will be commenced at once. Local subscriptions to the amount of $10,000 have been secured, and it is understood that the remainder of the amount required to cover the cost of the plant will be furnished by outside parties. The present plan is to construct a dam on the Loup River, north of Burwell, at which point 1000 hp can be developed. A number of towns in the valley are considering the utilization of the energy generated, and plans are being formulated for the construction of an electric line frim Burwell to Taylor and Almeria.

FREMONT, NEB.—The installation of a new lighting system in the Court House at this city has been authorized by the County Board.

GRAFTON, NEB.—It is reported that L. R. Jensen, of Aurora, Neb., has secured the contract for the installation of an electric-light plant in Grafton, to cost approximately $15,000.

OMAHA, NEB.—Arrangements are being made by the Omaha & Council Bluffs Street Railway Company for rebuilding its substation on the Manawa line, which was recently destroyed by fire.

STERLING, NEB.—The citizens are reported to be considering the installation of an electric-light plant and water-works system in Sterling.

WEEPING WATER, NEB.—Plans and specifications have been submitted to the City Council by H. H. Henningsen, of Omaha, Neb., for the construction of an electric-light plant in Weeping Water. The plans call for an addition to the pump-house and the installation of two additional engines. Bids for construction of the plant will be received until Aug. 28. The Alamo Engine & Supply Company, of Omaha, Neb., has charge of the engineering work.

GOODSPRINGS, NEV.—Plans are being considered for the erection of a new power plant at the Yellow Pine mine. J. F. Kent is manager.

ALBANY, N. Y.—Contracts have been placed by the Delaware & Hudson Company with the General Electric Company for one 7500-kw turbine, one 100-kw turbo-exciter and four 2500-kva transformers. The new equipment will supply additional power for the company's electric railway service in Albany, Troy and Schenectady, and will also furnish electricity for its new shops at Watervliet, N. Y.

BOLTON LANDING, N. Y.—The Bolton Light & Power Company has petitioned the Public Service Commission, Second District, for authority to issue $12,500 in capital stock.

BUFFALO, N. Y.—Sealed proposals will be received at the office of Department of Public Works, Room 5, Municipal Building, Buffalo, N. Y., until Aug. 29 for furnishing 106 five-lamp, 60-watt Union Lamp Standard luxolabras of pressed steel or their equal, complete with glassware, sockets, lamps, etc. Dimensions, materials and glassware to be equal or to be the same as used in Genesee Street. Francis G. Ward is commissioner.

EPHRATAH, N. Y.—The Mohawk Hydroelectric Company has applied to the Public Service Commission, Second District, for permission to issue 6 per cent thirty-year gold bonds to the amount of $56,000, the proceeds to be used for the construction of a substation and the erection of transmission lines from its generating station in Ephratah to the villages of Fort Plain and Nelliston.

KEESEVILLE, N. Y.—The Keeseville Electric Company has applied to the Public Service Commission, Second District, for permission to erect transmission lines and exercise franchises for supplying electricity in the towns of Jay, Essex County, and Ausable, Clinton County.

NAPLES, N. Y.—Permission to install and operate an electric light plant in this city, application for which was noted in our last issue, has been granted to Edward L. Bailey, of the Dundee Electric Lighting Plant, and plans are being made by him to enter into competition with the Natural Gas Company.

NEWBURGH, N. Y.—At a joint conference of the lighting committee of the Merchants' Association, the police and light committee of the City Council and officials of the Central Hudson Gas & Electric Company, held recently, tentative plans were considered for the installation of a new lighting system along Golden and Water Streets, from Broadway to South Street.

OLEAN, N. Y.—The Olean Electric Light & Power Company has filed a certificate with the Secretary of State asking for permission to extend its service to take in the town of Geneva, Allegany County, and the towns and villages of Portville and Allegany.

SMITHTOWN, N. Y.—The Long Island Lighting Company has applied to the Public Service Commission, Second District, for permission to erect transmission lines for the distribution of electricity in Smithtown and for authority to issue $90,000 in bonds under an existing mortgage.

YAPHANK, N. Y.—The Almshouse Committee has been authorized by the Suffolk Board of Supervisors to proceed with the work of equpping the almshouse and children's home at Yaphank with an electric-lighting system. Mr. Miller, of Easthampton, formerly chairman of the board, has been placed in charge of the proposed installation, which it is estimated will cost about $2,000. Although no definite contract has been made, it is undrstood that energy for the operation of the plant will be transmitted from Patchogue.

FARGO, N. D.—Sealed proposals will be received by E. R. Orchard, city auditor, until Sept. 5 for the construction of a pumping station and electric-light plant, plans and specifications for which are on file at the office of the city auditor.

FARGO, N. D.—The Union Light, Heat & Power Company of Fargo, N. D., has submitted a proposition to the City Council offering to furnish electricity for street lighting at cost and to give the city 2 per cent of its gross earnings, in return for which the company asks for franchises to extend its system in all parts of the city. The franchise of the company for street lighting expires Sept. 1.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company will place contracts in the near future for an additional compound steam engine or turbine unit in its power plant in Bowling Green. An automatic stoker will probably be installed.

CLEVELAND, OHIO.—Proposals will be received at the office of the clerk of Board of Education, East Sixth Street, Cleveland, Ohio, until Sept. 11, for construction of school building to be known as the Willard Avenue Technical High School, in accordance with plans and specifications on file at the office of the Board of Education, East Sixth Street. The price for material and labor must be stated separately, and bidders may submit proposals for any or all of the following apparatus: Slate blackboards, electric wiring, electric-lighting fixtures, clock system, elevators, steel lockers, special furniture, composition floors, chemistry department equipment, forge-shop equipment, woodworking shop equipment, mill-room equipment. Charles Orr is director of schools.

HUDSON, OHIO.—A fire at the Boys' Home, which is conducted by the city of Cleveland near Hudson, resulted in the total destruction of the power house, carpenter shop and storeroom. The loss will amount, it is believed, to approximately $15,000.

NORTH LIMA, OHIO.—The depot and substation of the Youngstown & Southern Railway Company at North Lima was destroyed by fire recently, causing a loss of about $30,000.

UPPER SANDUSKY, OHIO.—Newspaper reports state that the Upper Sandusky Board of Education expects to construct an up-to-date power plant in the northwestern portion of the grounds of the Union school building, in which the present heating system will also be installed.

COWETA, OKLA.—Preparations are being made for extensions to the municipal electric-light plant and water-works system, for which bonds to the amount of $20,000 have been voted.

OKLAHOMA CITY, OKLA.—The Oklahoma-Shawnee Railway Company will apply for a charter to build an electric railway to connect Oklahoma City, Shawnee and Tecumseh, with a branch line to Chandler, a distance of 100 miles. This company is a reorganization of the Oklahoma-Shawnee Interurban Railway Company. The capital stock is placed at $3,000,000. L. E. Patterson, of Oklahoma City, Okla., is president.

KLAMATH FALLS, ORE.—The Department of the Interior has notified the Klamath Water Users' Association that the reclamation service will not develop the Keno, Ore., power site at this time, nor will same be immediately disposed of.

PORTLAND, ORE.—Plans are being made by the Mount Hood Railway, Light & Power Company for the construction of a substation at the foot of Williams Avenue, Portland, to cost about $60,000.

PORTLAND, ORE.—Application has been made by the Portland & West Coast Railroad & Navigation Company for a charter to build an electric railway to connect Minnville and Bay City, via Willamina, Grande Ronde, Tillamook, Sheridan and Pacific City. The company also proposes to supply electricity for lamps and motors in Sheridan, Willamina and Tillamook. Power for operating the plant will be secured from the Little Nestucca River. The company also proposes to operate steamboats on the Yamkill, Nestucca, Siletz and Tillamook Rivers, and on Tillamook Bay and the Pacific Ocean. The capital stock of the company is placed at $1,000,000. The incorporators are: W. F. Prier, C. F. Hendricksen and Jay H. Upton.

BATH, PA.—The Town Council has passed an ordinance providing for the installation of a municipal electric-light plant.

HARRISBURG, PA.—The capital stock of the Harrisburg Electric Service Company has been increased from $5,000 to $2,000,000.

PHILADELPHIA, PA.—A permit has been granted to the H. E. Gran Company for the erection of a $10,000 power house on the south side of Chester Avenue, west of Fifty-ninth Street, which will supply electrical energy to the Presbyterian Orphanage.

SHICKSHINNY, PA.—By a unanimous vote the Shickshinny Councilmen passed an ordinance disposing of the municipal electric light plant to the Luzerne County Gas & Electric Company for the sum of $10,500, the transfer to be made September 1, at which time the Luzerne company expects to be able to furnish electrical energy in Shickshinny. Should there be any delay in so doing, the new owners will take over the new plant and run it until energy can be transmitted from its power house at Plymouth.

HONEA PATH, S. C.—Bids will be received by the Board of Public Works until Sept. 5 for the construction of an electric-light plant. The plant will cost approximately $11,000 and have an output of approximately 75 kw. John F. Monroe is chairman of board.

LEXINGTON, S. C.—The Lexington Electric Light & Power Company is reported to be contemplating the installation of an auxiliary steam plant in its power house.

BRUCE, S. D.—The installation of an electric-light system in Bruce is reported to be under consideration.

PLANKINGTON, S. D.—It is reported that W. A. Kuntz, to whom the City Council recently granted a franchise to install and operate an electric-light plant in Plankington, has closed a contract with the State Board of Charities and Correction whereby his plant will furnish energy for lighting at the State Industrial School, situated on the outskirts of Plankington.

SIOUX FALLS, S. D.—The plant and holdings of the Sioux Falls Light & Power Company are reported to have been purchased by H. M. Byllesby & Company, of Chicago, Ill. The new owners, it is understood, will make improvements and extensions to the system.

BUCKHOLTS, TEX.—It is reported that W. R. Newton is contemplating the installation of an electric-light plant in the sanitarium.

CRYSTAL CITY, TEX.—The installation of an electric-light plant and ice plant is under consideration. The Commercial Club is promoting the project.

CUERO, TEX.—The Cuero Light & Power Company is extending its transmission to Dr. Burns' new sanitarium and is also erecting a special line to the Cuero packing plant to supply water to operate the cold-storage plant.

WACO, TEXAS.—It is stated that should the Waco Electric Light Company fail to submit a more liberal contract for lighting the city streets, a municipal electric-light plant will be installed at an early date, a $250,000 bond issue for the purpose having been voted by the citizens of Waco some months ago.

JENSEN, UTAH.—John T. Pope is reported to be interested in the construction of an irrigation system in Umtah County. It is proposed to build a dam across the Green River, 400 ft. high, about 7 miles from Jensen. The installation of a power plant is also contemplated in connection with the irrigation system.

RUTLAND, VT.—Preparations are being made by the Rutland Railway, Light & Power Company for the construction of a dam 96 ft. high and 100 ft. long in the lower gorge on Mill River in Clarendon. The company already has a transmission line running within a short distance of the proposed new dam.

SHELBURNE FALLS, VT.—Initial steps have been taken by the promoters of the hydroelectric development of the Deerfield River near Shelburne Falls by the completion of an underwriting agreement for the issuance of $3,000,000 in bonds and $750,000 in capital stock. It is understood that the project will ultimately involve an expenditure of about $12,000,000. The present plans provide for a development of 25,000 hp. It is proposed to build four dams on the river near Shelburne Falls, Vt., and to erect a reservoir at Somerset, Vt., where water will be impounded, covering an area of approximately six square miles. Interests connected with the Connecticut River Power Company, of Burlington, Vt., are said to be interested in the project.

LAWRENCEVILLE, VA.—Bonds to the amount of $50,000 have been voted, the proceeds to be used for the construction of an electric-light plant, water-works and sewer systems, plans for which have been prepared by J. B. McCrary & Company, Empire Building, Atlanta, Ga.

DAYTON, WASH.—A notice of appropriation of water to the amount of 1000 cu. ft. a second, at a point on the Tucanon River about 28 miles southeast of Dayton, has been filed by E. S. Isaacs, of Walla Walla, the purpose of the appropriation being the installation of a plant for the generation of electrical energy.

DAYTON, WASH.—R. H. Kribs, of Pomeroy, has filed with the auditor of Columbia County a notice of appropriation of 100 cu. ft. per second of water in the Tucanon River, about 30 miles east of Dayton. The notice sets forth that the purpose of the appropriation is to generate electrical energy for industrial and commercial purpose.

MESKILL, WASH.—Preparations are being made for the installation of an electric lighting plant at the new rock-crushing plant of the State in Meshkill. P. E. Robbins is State superintendent of quarries.

MOUNT VERNON, WASH.—The plant and holdings of the Mount Vernon Electric Light & Power Company have been acquired by the Stone & Webster Management Association, of Boston, Mass. The consideration is said to be $26,000. Improvements will be made to the system, including the erection of a new substation to supply energy to the Bellingham-Mount Vernon Interurban Railway. Robert Bowels will be local manager.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has applied to the County Commissioners for a franchise to erect transmission lines to supply electricity in White Bluffs and Benton City.

OLYMPIA, WASH.—It is announced that L. B. Faulkner, manager of the Olympic Light & Power Company, is securing the rights-of-way for the transmission line which his company is constructing in Thurston County. A large power plant is being erected at Lake Lawrence, a few miles out of Olympia, and work on a reservoir which will cost $30,000 has been commenced. When completed it is estimated that the plant will represent an expenditure of approximately half a million dollars.

PORT ORCHARD, WASH.—The contract for the installation of the power plant at the Veterans' Home has been awarded by the State Board of Control to J. C. Corbin & Company, of Seattle, Wash., for $13,987.

SEDRO-WOOLEY, WASH.—It is proposed to install a complete power and generating plant in connection with new Northern Hospital. Contract for erection of buildings has been awarded at $115,000.

SOUTH BEND, WASH.—The power house of the Twin City Electric Company will be located midway between South Bend and Raymond.

WARWOOD, W. VA.—Plans are being considered to organize a company to establish an electric plant to supply electricity for lamps and motors in Warwood. Steps will be taken at once to secure a charter for the company, and a franchise to operate in Warwood.

CHETEK, WIS.—The local electric-light plant, owned by W. J. Gavin, is reported to have been destroyed by fire.

FOND DU LAC, WIS.—Plans are being considered by the Eastern Wisconsin Railway & Light Company for the erection of an addition to its plant, located at North Main and Rees Streets, to cost about $12,000. New stoking apparatus will be installed.

MARIETTA, WIS.—The Harmony Telephone Company, which is capitalized at $10,000, has been organized to construct a telephone line from Harmony Corners to Marietta. H. L. Reeves, Oconto, is manager.

MILWAUKEE, WIS.—Work has commenced on the foundation of the new substation of the Milwaukee Electric Railway & Light Company, located at Twentieth Street and North Avenue, Milwaukee, Wis.

STOUGHTON, WIS.—The City Council will soon advertise for bids for construction of new power house for the municipal electric-light system, to cost about $6,000.

WINNIPEG, MAN., CAN.—Sealed tenders will be received by the chairman of Board of Control for furnishing and installing underground cable for the electrical distribution system. Specifications and form of tender may be obtained at the office of the general manager of the Light and Power Department, 449 Main Street, Winnipeg, Man. M. Peterson is secretary of Board of Control.

MIDDLETON, N. S., CAN.—The ratepayers have voted to appropriate from $15,000 to $20,000 for the installation of an electric-light system in Middleton. James A. Gates is town clerk.

ST. MARY'S, ONT., CAN.—It is stated that through a recently consummated deal the town of Seaforth has become the owner of the 13,000-volt electrical equipment of the Water, Light & Heat Commission of St. Mary's, the purchase price being $1,000. The sale was effected by the Hydroelctric Commission, and the equipment will be transferred to Seaforth by the Canadian General Electric Company.

ST. MARY'S, ONT., CAN.—Arrangements have been concluded by the North Midland Electric Railroad for the construction of an electric line from London to St. Mary's and Stratford, with branch lines to Granton and other points in the district. The company will also build switch lines to all of the factories of the town, energy for the operation of the system to be obtained from the St. Mary's substation.

MONTREAL, QUE., CAN.—The civic experts who were appointed to take charge of preparing plans for the construction of the municipal underground conduit system have recommended to the Board of Control that an appropriation be made to open an office in the city and engage a competent staff to carry on the work. The cost of proposed system is estimated at about $5,000,000. The city will charge rental to electric companies for space occupied in the conduit.

ST. JEROME, QUE., CAN.—Tenders will be received until Aug. 28 for the erection of a complete hydroelectric power and distributing system, to cost approximately $60,000. For specifications apply to De Gaspe Beaubien, 112 St. James Street, Montreal, Que., Can.

New Industrial Companies.

THE BULLOCK-KENNEDY COMPANY, of Troy, N. Y., has been chartered with a capital stock of $10,000 by Phillip N. Bullock, of Troy, N. Y.; John W. Kennedy, of Watervliet, N. Y., and Albert J. Crawmer, of Troy, N. Y. The company proposes to do a general electrical engineering business and electrical work of all kinds.

THE DAKOTA ENGINEERING & SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture engineering tools and supplies. The incorporators are: Simon Mohrbach, 87 Hamilton Place; Daniel O'Connell, 323 East Eighty-third Street; James A. Lynch, 333 West Seventy-eighth Street, all of New York, N. Y.

THE ELECTRIC SUPPLY COMPANY, of Little Falls, N. Y., has been incorporated by S. H. Newberry, William H. Coffey, Edward W. Gearhead and Robert D. Dodge. The company is capitalized at $2,500 and proposes to manufacture electrical supplies.

C. G. EVERSON & COMPANY, of Chicago, Ill., have been incorporated by R. B. Everson, H. V. Willman and C. G. Everson. The company is capitalized at $40,000 and proposes to manufacture electrical goods.

THE FEMES MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by John T. Booth, Otto Foell and G. W. Williams. The company proposes to manufacture and deal in electrical supplies.

THE GEORGE W. JACKSON ENGINEERING COMPANY, of Yonkers, N. Y., has been incorporated with a capital stock of $300,000 by H. R. Griffith, J. C. Connell, of New York, N. Y., and F. L. Madden, of Ossining, N. Y. The company proposes to do a general mechanical engineering busness.

THE LOS ANGELES VACUUM CLEANING COMPANY, of Los Angeles, Cal., has been incorporated by P. G. Mueller, W. D. Lacey and J. C. Rommel. The company is capitalized at $10,000.

THE LUX MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000, for the purpose of dealing in electrical supplies. The incorporators are: John T. Booth, Guy V. Williams and Lewis V. Hulse.

THE NATIONAL INSULATOR COMPANY, of Camden, N. J., has been incorporated by Jesse E. Innuian, 331 Caper Street, Hartford, Conn.; John F. Harned, 424 Market Street, Camden, N. J., and William C. Aitkin, 334 Penn Street, Camden, N. J. The company is capitalized at $500,000 and proposes to manufacture glass and other insulators for electric current, etc.

Personal.

PROF. A. M. WILSON has resigned as professor of electrical engineering at the Kentucky State University to accept a similar chair at the University of Cincinnati.

MR. GEORGE W. PERRY has been elected general manager of the Weymouth (Mass.) Light & Power Company to succeed Mr. Milton A. Carter, who has resigned that office.

MR. ARTHUR WRIGHT, the well-known English central-station engineer and originator of the Wright demand system of central-station charging, sailed for New York this week.

MR. S. Z. FERRANTI, of London, well known throughout the world for his pioneer work in alternating-current engineering, will arrive at New York on Aug. 26 and will remain in this country until about the middle of September.

MR. S. H. GLUCROFT has resigned as illuminating engineer of the Wilmington & Philadelphia Traction Company, to become consulting engineer and sales manager of the General Illuminating Company, with headquarters in New York.

MR. W. H. WHITESIDE, formerly president of the Allis-Chalmers Company, has been elected president and a director of the Stevens-Duryea Company, of Chicopee Falls, Mass., one of the leading automobile manufacturing concerns of the country.

MR. MAX LOEWENTHAL has recently joined the forces of the Philadelphia Electric Company, in the capacity of manager of the showroom and sales department. Mr. Loewenthal has had a wide experience in the electric-heating and appliance field, which amply fits him for his new duties.

MR. PETER W. SOTHMAN, chief engineer of the Hydroelectric Power Commission of Ontario, has returned from his trip to Europe, whither he went with members of the commission on April 25, to study certain phases of electrical development abroad in connection with the commission's work in Canada.

MR. C. A. COFFIN, president of the General Electric Company, sailed with his family on Saturday for an automobile trip on the Continent of Europe. Mr. Coffin had passage booked on the S. S. *Olympic,* and will be gone over a month. Accompanying the party was Mr. Hinsdale Parsons, general counsel of the company.

MR. F. E. DRAKE, until recently in charge of the Westinghouse Electric Manufacturing interests in France, Italy and Austria, has received a contract for the track and permanent-way work on a new system of electric railways for Palermo, Italy. The first section will be finished by Dec. 1, and the second section by the latter part of next year.

MR. CHARLES H. MERZ, consulting electrical engineer of London, sailed for New York the present week. In addition to his connection with many important British electrical works as designing or consulting engineer, including the Tyneside district electrical supply plant, Mr. Merz has

acted as adviser for the State of Victoria, Australia, and for the Central Argentina Railway Company with reference to the electrification of its Buenos Aires suburban lines.

MR. ROBERT F. PACK, for many years secretary of the Toronto Electric Light Company, Ltd., of Toronto, Ontario, has been appointed general manager of the company by the MacKenzie interests, which recently added the lighting company to their group of other public utilities in the Province of Ontario. Mr. Pack was born on the Isle of Wight in 1874 and educated for the Royal Navy at the Portsmouth Grammar School. In 1889, however, his course was cut short by the removal of his parents to Canada, then showing signs of its present prosperity. Shortly after becoming settled Mr. Pack entered the employ of the Great Northern Telegraph Company, where he remained for about one year. At about that time the Toronto Electric Light Company became a factor in the development of the city of Toronto and Mr. Pack joined himself to that company, remaining with it ever since. His appointment as general manager is a most popular one, Mr. Pack having worked his way through the various grades to the post of secretary prior to his present promotion. As a member of the Canadian Electrical Association he has done much to further the development of electricity in Canada, imbibing all that American practice had to offer through membership in the National Electric Light Association. To him is due the formation of the Toronto N. E. L. A. Company Section, and, naturally, he was also instrumental in getting the Canadian association to affiliate with the N. E. L. A.

ROBERT F. PACK.

Obituary.

MR. JOHN G. JENNINGS, superintendent of telegraph of the Chicago, Rock Island & Pacific Railroad Company, died at his home in Chicago on Aug. 19. He was born in Bellaire, Ohio, in 1862, and for seven years had filled the position he held at the time of his death.

Trade Publications.

SINGLE-PHASE MOTORS.—The General Electric Company has just revised its bulletin (No. 4858) devoted to single-phase repulsion motors.

ROTARY CONVERTERS.—Bulletin No. 4868, recently issued by the General Electric Company, illustrates and describes rotary converters for railway and lighting, in capacities ranging from 25 to 2500 kw. The bulletin illustrates also a portable substation in which a converter is installed.

INSTRUMENTS FOR SWITCHBOARD SERVICE.—The General Electric Company has recently issued Bulletin No. 4866 on Thomson horizontal edgwise instruments for switchboard service, which supersedes all previous bulletins issued by this company devoted to this type of instrument.

ELECTRIC LOCOMOTIVES.—The C. W. Hunt Company, West New Brighton, N. Y., has issued Catalog No. 11-5, containing a description of its electric locomotives, together with illustrations of plants showing the locomotive in operation under varying conditions. The locomotives are built in the storage-battery and trolley types, and in a combination of both.

INDUCTION MOTORS.—T. W. Broadbent, Ltd., Huddersfield, England, has issued illustrated leaflet No. 10 devoted to induction motors of the single-phase, two-phase and three-phase types, in which special attention has been paid to ability to carry overloads. The primary coils are wound with asbestin-insulated wire, the insulating materials being selected with a view to withstanding the high temperatures arising from heavy and frequent overloads.

ELECTRICAL SUPPLIES.—The H. W. Johns-Manville Company, New York, has issued Catalog No. 15, containing over 400 pages, illustrating and describing the electrical products of the company, together with a line of electrical supplies. Usually sufficient descriptive matter is included to enable the customer to determine readily the exact material required. The book provides a ready reference to "J-M" products, as it is well arranged and completely indexed, making it easy to locate the apparatus quickly.

ENGINE-TYPE ALTERATIONS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued Bulletin No. 1080, superseding Bulletin No. 1048, and describing the company's engine and the flywheel types of alternating current generators. It will, of course, be understood that the Allis-Chalmers alternators are built for all classes of service. The bulletin contains numerous illustrations, showing the application of the alternators in central-station practice, and also showing detail parts of the winding, armature coils, pole pieces, etc.

BUSINESS NOTES.

THE HYGRADE INCANDESCENT LAMP COMPANY, Danvers, Mass., announces that in order to show its confidence in the efficiency of its product the offer is made to give credit for any tungsten lamps broken in transit.

MR. C. P. LINDSLEY, president of the Lindsley Brothers Company, manufacturers of Western cedar poles and cross-arms, Spokane, Wash., is making an extended inspection trip to the company's pole yards, which are located in northern Idaho, northeastern Washington and British Columbia. The British Columbia headquarters are at Nakusp on Arrow Lake.

THE VOHR OZONE ELECTRIC COMPANY, with offices at 506 South Fifth Avenue, Chicago, has been organized to manufacture and distribute the Vohr Electric Ozonizer, under the licenses and patents of the Standard Electric-Utilities Company, which formerly made the Vohr device. The officers of the Vohr Ozone Electric Company are: President, F. A. Hill; vice-president, A. B. Adair; secretary, Oscar Lindner, and treasurer, W. H. Wright.

THE ALBERGER CONDENSER AND ALBERGER PUMP COMPANIES have opened a branch office at 97½ Peachtree Street, Atlanta, Ga., which will be under the care of Mr. R. S. McMichael. The Pacific branch office of these companies, located at 503 Market Street, San Francisco, is now in charge of C. F. Braun & Company, Inc., of which new corporation Carl F. Braun is president, George C. Singletary vice-president, and Emory S. Singletary secretary. The corporation succeeds that formerly known as Braun, Williams & Russell.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, of Warren, Ohio, will on or about Sept. 1 transfer its offices to the company's new office building on West Summit Street. The sales force of the Sterling company, including the various district managers, the traveling representatives and the home office employees, have been spending a profitable week in the company's camp at Riverside Farm, on the Mahoning River, Warren. Daily conferences on the technical and commercial aspects of the incandescent lamp, interchanges of sales experiences, addresses by lamp manufacturing experts and illuminating engineers, present as invited guests, mingled with plenty of outdoor exercise, fresh air, fresh food and fishing, have put the men in the best possible shape for the work of the coming season.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 15, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,000,384. MOTOR-STARTING SWITCH; F. G. Dustin, Minneapolis, Minn. App. filed Feb. 6, 1911. Arrangement of contacts, carrier handle and lock for alternating-current work.

1,000,389. INSULATOR BRACKET; C. G. Ette, St. Louis, Mo. App. filed Aug. 31, 1910. A yoke and hinged strap for embracing a cross-arm,

1,000,392. MAGNETIC SEPARATOR; E. J. Feeley, Fairfield, Conn. App. filed Feb. 18, 1911. The material to be separated is positively moved past rows of relatively staggered magnetic poles of opposite polarity.

1,000,396. APPARATUS FOR PRODUCING ELECTRIC OSCILLATIONS; R. C. Galletti, Rome, Italy. App. filed Dec. 4, 1908. Inductances and capacities are connected in series and provided with means for producing a continuous progression of discharge.

1,000,397. PRODUCTION OF CONTINUOUS WAVE-TRAINS BY MEANS OF PRIMARY SPARK CIRCUITS; R. C. Galletti, Lyons, France. App. filed June 24, 1910. The spark discharges are produced quickly or continuously following each other.

1,000,401. SIGNALING SYSTEM FOR RAILWAYS; H. W. Griffin, New York, N. Y. App. filed Sept. 21, 1908. A circuit including an interlocking relay operates to "clear" a single track switch indicator for one direction of traffic and set it to "danger" for the opposite direction.

1,000,402. SIGNALING SYSTEM FOR RAILWAYS; H. W. Griffin, New York, N. Y. App. filed Sept. 21, 1908. The position of one signal is dependent upon the position of the opposing signal.

1,000,421. PRIMARY ELECTRIC BATTERY; G. A. Lutz, Plainfield, N. J. App. filed May 29, 1909. Improvement on Patent No. 919,900. The depolarizer comprises a plate of cupric oxid and the positive electrode zinc. Means for holding the plates spaced apart.

1,000,440. ELECTROMAGNET COIL; F. W. Reeves, Pittsburgh, Pa. App. filed Dec. 28, 1909. The inner coils have a greater carrying capacity than the outer.

1,000,456. APPARATUS FOR BRAZING OR SIMILAR WORK; C. R. Sturdevant, Worcester, Mass. App. filed July 9, 1910. Apparatus for supporting and manipulating the bond terminal clamp.

1,000,471. ELECTRIC LAMP; S. P. Wilbur, Pittsburgh, Pa. App. filed Sept. 14, 1909. A spring support, having bifurcated hook-like ends gripping the enlarged terminal ends of the "glover."

1,000,482. ELECTRICAL THERMOSTAT; W. P. Allen, Moon Township, Pa. App. filed July 11, 1910. A confined body of air acts against a smaller and cooler body of confined air to operate automatically a non-metallic diaphragm.

1,000,488. PARTY-LINE TELEPHONE SYSTEM; W. M. Bruce, Jr., Springfield, Ohio. App. filed Aug. 16, 1907. To enable the operator to signal one only of the parties at one time and to prevent "breaking in" on a party line when in use.

1,000,493. INSULATOR FOR ELECTRIC RAILWAY CARS; J. Christensen, Evans City, Pa. App. filed Sept. 27, 1910. For suspending rheostats, etc. The supporting bolts and heads are incased in insulation.

1,000,499. TELEPHONE TRANSMITTER; W. W. Dean, Elyria, Ohio. App. filed April 24, 1908. The diaphragm has a flanged periphery which supports it as its outer edge. The expansion due to heat tends to free the granular material.

1,000,535. INSULATOR; L. McCarthy, Boston, Mass. App. filed Feb. 26, 1909. Ball and socket members embedded in insulation and having grooves for the insulation, to prevent turning.

1,000,536. ELECTRIC-SWITCH-OPERATING ROD; C. R. Meston, and H. I. Finch, St. Louis, Mo. App. filed July 6, 1910. A jointed rod with couplings.

1,000,572. SIGNALING APPARATUS; G. F. Atwood, East Orange, N. J. App. filed Feb. 20, 1906. A telephone set for use in fire-control systems for artillery, etc.

1,000,601. INK-WRITING TELEGRAPH REGISTER; B. Hurd, Nutley, N. J. App. filed Dec. 16, 1907. The tape-feeding mechanism is wound up when one or more of a plurality of inking elements are actuated.

1,000,608. ELECTROLYTIC APPARATUS; J. W. Kenevel, Philadelphia, Pa. App. filed Sept. 22, 1910. The electrodes are supported by the hoods which cover a porcelain-lined chamber. For destroying animalcules and coagulating solids held in water.

1,000,614. WIRING SYSTEM FOR AUTOMATIC TELEPHONE EXCHANGES; F. R. McBerty, New Rochelle, N. Y. App. filed Aug. 16, 1909. One of the pairs of conductors in one of two parallel sets is connected in circuit in reverse order to that of the other pairs in the set to prevent cross-talk.

1,000,661. THERMOSTAT; I. F. and F. C. Beers, Rochester, N. Y. App. filed Feb. 23, 1910. A coil spring is interposed between the ends of sections inside a tube, the sections and tube having different coefficients of expansion.

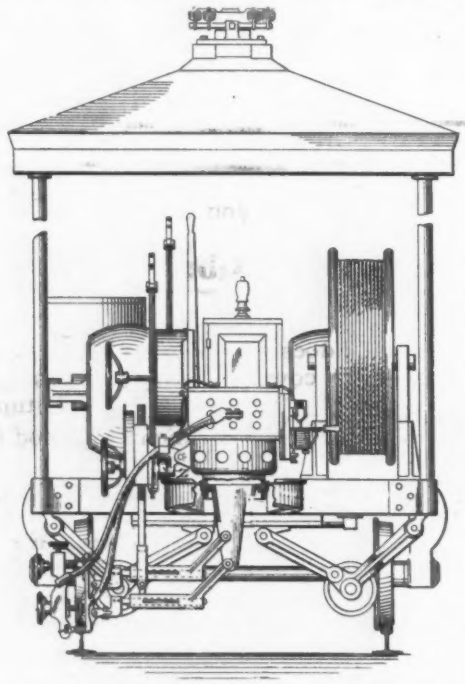
1,000,679. SUPPORTING AND PROTECTING DEVICE FOR THIRD RAILS; G. S. Inman, Chicago, Ill. App. filed Oct. 2, 1908. Laterally arranged grooved sections of reinforced concrete for grasping the edges of the bottom flange of an inverted rail.

1,000,687. COMBINED DOOR-KNOB AND PUSH-BUTTON; P. J. O'Donnell, Newark, N. J. App. filed Jan. 24, 1910. A series of push-buttons are arranged around the periphery but do not project.

1,000,717. FLAMING-ARC CARBON; W. T. Conn, Lakewood, Ohio. App. filed March 29, 1909. An aluminum resistance-reducing wire extends through the electrode and has one end bent over. The wire is coated to prevent corrosion.

1,000,761. PROCESS OF APPLYING PROTECTING GLAZE TO CARBON ELECTRODES; J. L. K. Snyder, Cleveland, Ohio. App. filed Sept. 6, 1910. A slag producing protective coating is applied to the green unbaked electrode before the usual baking.

1,000,776. DYNAMO-ELECTRIC MACHINE; J. L. Burnham, Schenectady, N. Y. App. filed April 12, 1909. Self-exciting commutator type for variable voltage. An auxiliary brush is provided intermediate the main brushes, a constant induced armature voltage is maintained between the auxiliary brush and one main brush, and the induced armature voltage between the auxiliary brush and the other main brush is varied.

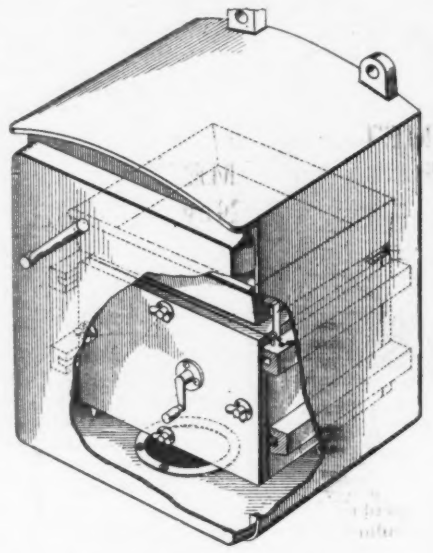


1,000,456.—Apparatus for Brazing or Similar Work.

1,000,779. TROLLEY-CONTROL SYSTEM; F. E. Case, Schenectady, N. Y. App. filed Aug. 24, 1910. Pneumatic means for automatically retracting the trolley is electromagnetically actuated upon overload.

1,000,795. TELEPHONE-TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Aug. 11, 1910. The transmitter is air, moisture and dust-proof.

1,000,805. ELECTRIC FURNACE; A. Helfenstein, Vienna, Austria-Hungary. App. filed July 21, 1910. The top of the furnace and the receptacle for the charge are supported by girders, and two separate gas-eliminating chambers are formed when the full charge is used.



1,000,572.—Signaling Apparatus.

1,000,825. CONDUIT CREEPER; H. C. Lehman, Winder, Pa. App. filed Nov. 6, 1909. Laterally disposed pivoted gripping jaws are operated by a shiftable cam. For cylindrical and polygonal conduits.

1,000,838. ELECTRICAL FURNACE; H. Nathusius, Friedenshütte, Germany. App. filed June 24, 1909. Modification of Patents Nos. 958,757 and 983,303. Alternating currents of different intensities are simultaneously passed through the material and a neutral zone of alternating-current circuit is maintained in the bath.

1,000,846. MEANS FOR COOLING DYNAMO-ELECTRIC MACHINES; H. Roos, Berlin, Germany. App. filed Dec. 8, 1909. The space blocks in the radial ventilating spaces form channels separated from each other. See Patents Nos. 957,102 and 957,103.

1,000,847. BURGLAR ALARM; G. A. Sabine, Robinson, Md. App. filed Aug. 5, 1910. For outlying buildings. A normally open circuit and device for closing it at regular intervals.

1,000,848. STARTING AND SPEED-REGULATING RHEOSTAT; F. J. Seabolt, Schenectady, N. Y. App. filed Jan. 24, 1910. Two sets of contacts and an arm movable in one direction for starting and in the opposite direction for varying the running speed and a ratchet for controlling the latter.

1,000,854. TROLLEY WHEEL; L. J. Tetlow, Holyoke, Mass. App. filed May 4, 1909. Composed mostly of iron with conducting portions of brass or copper and lubricating means.

1,000,864. MOTOR-CONTROL APPARATUS; D. Wald, O. C. Britsch and M. Taigman, New York, N. Y. App. filed April 15, 1911. A brake is applied when the power is shut off. For sewing-machine drive, etc.

1,000,871. IMMERSION HEATER; G. C. Young, Oceano, Cal. App. filed Aug. 9, 1910. Two electrodes in a perforated casing. The fluid to be heated is used as a resistance medium. For heating small quantities as in cups, etc.

1,000,902. CALLING DEVICE FOR ELECTRICAL EXCHANGE SYSTEMS; A. H. Dyson, Chicago, Ill. App. filed Feb. 16, 1906. An electro-mechanical number-recording machine, the numbers being recorded by means of electromagnetic switching devices at the exchange. A movable member with finger-holds.

1,000,925. CONDENSER; K. Kuhlmann, Berlin, Germany. App. filed April 29, 1910. A dielectric with its end divided into diverging portions so as to reduce the capacity of the edge and prevent breaking down.

1,000,934. PROTECTIVE DEVICE FOR DISTRIBUTION SYSTEMS; R. M. Ostermann, Bogota, Colombia. App. filed Nov. 2, 1908. Tripping relays are interconnected so that the movement of one into tripping position holds the other inoperative. For parallel transmission lines.

1,000,939. ELECTRIC RELAY; L. J. Le Pontois, New Rochelle, N. Y. App. filed July 24, 1908. For telephone or telegraph use. A driven disk is subject to the magnetic flux of an exciting coil.

1,000,941. MEASURING INSTRUMENT; W. H. Pratt, Lynn, Mass. App. filed Feb. 7, 1910. A series solenoid and a movable core comprising a potential coil and two windings inductively related and connected in series with the coil and solenoid.

1,000,942. ELECTRIC MEASURING INSTRUMENT; W. H. Pratt, Lynn, Mass. App. filed Feb. 24, 1910. A tapered coil is mounted to swing between a conical core and pole pieces having conical forces.

1,000,964. LAMP FOR MOTION-PICTURE MACHINES; J. H. Crosier, Philadelphia, Pa. App. filed July 20, 1910. The carbons are adjustable longitudinally and angularly and provided with special clamps.

1,000,967. ELECTRIC SEAM WELDING; M. J. Farquhar, Wilmington, Ohio. App. filed May 14, 1909. A welding current is sent through and progressively along the ridge of a joint (as a box joint) and light blows are applied in proximity to and progressively with the current.

Patent Delayed in Receipt; Aug. 8, 1911.

1,000,101. ELECTRICAL ATTACHMENT PLUG; G. C. Marx, Elizabeth, N. J. App. filed Sept. 28, 1906. The blocks of insulating material are molded with recesses for the metallic parts large enough to permit some play.